

**INTERNATIONAL MARKET OPPORTUNITIES
FOR
ENERGY EFFICIENCY TECHNOLOGIES AND SERVICES**

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Prepared By:

Alexander Ritschel
California Institute for Energy Efficiency
Manager Name: Carl Blumstein
Oakland, California
Contract No. 500-99-013

Prepared For:

California Energy Commission

Gary Klein
Contract Manager

Tim Olson
Project Manager

Terry Surles
Manager
PIER Program

Marwan Masri
Deputy Director
Technology Systems Division

Scott Matthews
Deputy Director
Transportation Energy Division

Robert L. Therkelsen
Executive Director

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Executive Summary

This study aims to identify the most promising international markets for the export of equipment or service that improves the energy efficiency either in the commercial and public service sector or in the manufacturing sector. More than hundred countries were scored on multiple energy-related, economic, and political attributes that are appropriate indicators of the potential value of each country as an export market.

Because of the large number of analyzed countries, including many developing countries, for which detailed data about energy efficiency is often not available, the study can give only a relatively rough comparison of the market potentials in each country. The study, therefore, should be only used as a basis for more detailed and in-depth studies of the identified priority markets.

Part I of this work provides the reader with data about energy consumption, fuel sources, value added, and energy intensity. The work gives information on a national level, for the commercial and public service sector, for the industry sector, and for industrial sub-sectors, such as the chemical, iron and steel, paper and pulp, food, or textile sector. In addition to energy-related data, one chapter focuses on various risk factors associated with carrying out business overseas.

Part II of this work uses the data provided in part I to screen about 100 countries regarding their potential as an export market for energy efficiency technologies. The screening analysis focuses on two different market sectors: the service and the manufacturing sector.

Part III of this work provides the reader with more detailed information about the energy efficiency status and energy efficiency policies in some of the priority markets identified in part II, for which detailed data was available, both for the service and for the manufacturing sector.

PART I - DATA SECTION

1. Introduction

Over the last 25 years in particular, businesses in the United States, Europe and Japan have become more and more focused on export markets as a key opportunity for business development. However, the expense and uncertainty associated with developing and marketing products to the export market are typically higher than they would otherwise be for products developed for the domestic market. Therefore, anything that can help to reduce either the cost or uncertainty of this activity should be valuable to (potential) exporters.

The California Energy Commission (CEC) is currently developing a data resource that makes it possible for potential exporters to target their energy-related products and services to those countries most likely to find them appropriate and valuable, thereby reducing uncertainty and reducing marketing costs. Energy technologies and services that will be covered are energy efficiency, geothermal, biomass, wind, solar, distributed generation (including combined heat and power), and natural gas and coal power plants.

In this work, which focuses on energy efficiency technologies, more than 100 countries are scored on multiple energy-related, economic, and political attributes that are appropriate indicators of the potential value of each country as a market for equipment or service that improves the energy efficiency either in the commercial and public service sector or in the manufacturing sector.

The data resource is based on the latest available data from various international and national organizations, such as the World Bank, the International Energy Agency (IEA), the United Nations Industrial Development Organization (UNIDO), etc. The market prioritization study combines a variety of different attributes (such as energy supply, energy demand, value added, purchase power parities, economic stability, political risk, etc.) in one single scoring tool. However, because of the large number of analyzed countries, the study can give only a relatively rough comparison of the energy efficiency potentials in each country. This limitation is mainly due to the lack of adequate data in many developing countries. In order to use a uniform methodology for comparing the energy efficiency potentials, we had to reduce the scope of this analysis to the least common denominator, for which data in all analyzed countries was available. The study provides the reader, therefore, with a rough estimate of the market potential for energy efficiency technologies, which should be used only as a basis for more detailed and in-depth studies of the identified priority markets. References for available and more detailed country-specific or regional studies are given at the end of this work.

2. Macro Indicators

This chapter gives an overview about some of the most important energy indicators on a national level.

2.1 Structure of the Economy

The following table lists the shares of the industrial, service, and agricultural sectors within the economy:

Country	Industry sector: Value added in 1999 as % of GDP	Service sector: Value added in 1999 as % of GDP	Agricultural sector: Value added in 1999 as % of GDP
Albania	25	22	53
Algeria	50	38	11
Angola	73	20	6
Antigua and Barbuda	19	77	4
Argentina	28	68	5
Armenia	32	38	29
Australia	26	71	3
Austria	33	65	2
Azerbaijan	33	48	19
Bangladesh	24	50	25
Barbados	22	72	6
Belarus	39	46	15
Belgium	28	71	1
Belize	27	53	20
Benin	14	47	39
Bhutan	37	28	35
Bolivia	17	63	20
Bosnia and Herzegovina	25	61	14
Botswana	45	51	4
Brazil	27	65	7
Bulgaria	27	56	17
Burkina Faso	18	46	36
Burundi	17	30	52
Cambodia	19	42	40
Cameroon	20	36	44
Cape Verde	18	70	12
Central African Republic	19	27	54
Chad	14	48	38
Chile	34	56	10
China	49	33	18
Colombia	28	58	14
Comoros	12	47	41

Country	Industry sector: Value added in 1999 as % of GDP	Service sector: Value added in 1999 as % of GDP	Agricultural sector: Value added in 1999 as % of GDP
Congo, Rep.	61	30	8
Costa Rica	35	54	11
Cote d'Ivoire	24	54	22
Croatia	33	57	10
Cuba	47	46	6
Czech Republic	41	55	4
Denmark	25	72	3
Djibouti	14	82	4
Dominica	23	59	19
Dominican Republic	34	54	11
Ecuador	37	50	12
Egypt, Arab Rep.	32	51	17
El Salvador	29	60	11
Equatorial Guinea	80	7	13
Eritrea	29	54	17
Estonia	26	68	6
Ethiopia	11	37	52
Fiji	29	53	18
Finland	33	63	4
France	26	71	3
Gabon	41	51	8
Gambia, The	13	49	38
Georgia	23	51	26
Germany	31	68	1
Ghana	25	39	36
Greece	24	68	8
Grenada	21	71	8
Guatemala	20	57	23
Guinea	38	38	24
Guinea-Bissau	12	27	61
Guyana	30	35	35
Haiti	20	51	29
Honduras	32	52	16
Hong Kong, China	14	85	0
India	26	48	26
Indonesia	43	37	20
Iran, Islamic Rep.	23	56	21
Ireland	36	60	4
Italy	29	68	3
Jamaica	31	62	7
Japan	32	66	1
Jordan	26	72	2
Kazakhstan	35	55	10
Kenya	18	59	23
Korea, Rep.	43	52	5

Country	Industry sector: Value added in 1999 as % of GDP	Service sector: Value added in 1999 as % of GDP	Agricultural sector: Value added in 1999 as % of GDP
Kyrgyz Republic	27	36	38
Lao PDR	23	24	53
Latvia	27	68	5
Lebanon	22	66	12
Lesotho	37	46	17
Lithuania	31	60	9
Luxembourg	21	78	1
Macedonia, FYR	33	55	13
Madagascar	14	56	30
Malawi	19	43	38
Malaysia	46	43	11
Mali	17	37	47
Marshall Islands	16	72	12
Mauritania	29	46	25
Mauritius	31	60	9
Mexico	29	67	5
Moldova	19	53	28
Mongolia	21	42	37
Morocco	32	53	15
Mozambique	24	46	30
Myanmar	9	31	60
Namibia	28	61	11
Nepal	22	37	41
Netherlands	27	70	3
Niger	17	42	41
Nigeria	35	28	37
Norway	36	62	2
Pakistan	24	49	27
Panama	17	76	7
Papua New Guinea	38	33	29
Paraguay	26	52	22
Peru	28	65	8
Philippines	31	52	17
Poland	36	60	4
Portugal	31	65	4
Romania	36	49	15
Russian Federation	35	57	7
Rwanda	21	35	44
Samoa	26	56	17
Sao Tome and Principe	17	62	21
Senegal	26	56	18
Seychelles	21	76	3
Sierra Leone	27	29	44
Singapore	35	65	0
Slovak Republic	32	64	4

Country	Industry sector: Value added in 1999 as % of GDP	Service sector: Value added in 1999 as % of GDP	Agricultural sector: Value added in 1999 as % of GDP
Slovenia	38	58	4
South Africa	31	66	3
South Asia	26	48	26
Spain	30	66	4
Sri Lanka	27	52	21
St. Kitts and Nevis	25	71	4
St. Lucia	19	73	8
St. Vincent and the Grenadines	25	64	11
Sudan	15	45	39
Suriname	21	68	10
Swaziland	44	39	17
Syrian Arab Republic	30	46	24
Tajikistan	25	57	19
Tanzania	16	38	46
Thailand	39	50	11
Togo	20	39	41
Tonga	15	55	31
Trinidad and Tobago	41	57	2
Tunisia	28	59	13
Turkey	25	59	16
Turkmenistan	46	26	28
Uganda	18	38	44
Ukraine	38	48	14
United Kingdom	29	70	1
Uruguay	27	67	6
Uzbekistan	25	42	34
Vanuatu	8	72	19
Venezuela, RB	36	59	5
Vietnam	34	40	25
Yemen, Rep.	42	42	16
Zambia	25	51	24
Zimbabwe	24	57	19

Tab. 2.1: Value added of industrial, service, and agricultural sectors as percentage of GDP in 1999

According to the World Bank, value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.

Data source: World Bank “World Development Indicators” (2002)

2.2 Energy Production by Fuel Type

The following table lists the shares of different fuels in the energy production mix.

Production is the production of primary energy, i.e. hard coal, lignite/brown coal, peat, crude oil, NGLs, natural gas, combustible renewables and wastes, nuclear, hydro, geothermal, solar and the heat from heat pumps that is extracted from the ambient environment. Production is calculated after removal of impurities (e.g. sulphur from natural gas).

	Coal [%]	Crude oil, NGL, Feedstocks, Non-crude oil [%]	Natural Gas [%]	Nuclear [%]	Hydro [%]	Biomass [%]	Geothermal [%]	Other [%]
Albania	1	39	1	0	52	7	0	0
Algeria	0	46	54	0	0	0	0	0
Angola	0	86	1	0	0	13	0	0
Argentina	0	50	41	2	2	4	0	0
Armenia	0	0	0	84	16	0	0	0
Australia	72	12	13	0	1	2	0	0
Austria	3	10	16	0	37	31	0	4
Azerbaijan	0	73	26	0	1	0	0	0
Bahrain	0	32	68	0	0	0	0	0
Bangladesh	0	0	47	0	0	52	0	0
Belarus	0	53	6	0	0	23	0	18
Belgium	0	0	0	94	0	3	0	3
Benin	0	3	0	0	0	97	0	0
Bolivia	0	32	52	0	3	14	0	0
Bosnia and Herz.	56	0	0	0	20	25	0	0
Brazil	2	43	4	1	19	32	0	0
Brunei	0	54	46	0	0	0	0	0
Bulgaria	47	0	0	46	3	5	0	0
Cameroon	0	57	0	0	2	40	0	0
Canada	10	32	38	5	8	3	0	4
Chile	4	5	22	0	16	53	0	0
China	60	15	2	0	2	20	0	0
Chinese Taipei	0	0	6	86	7	0	0	0
Colombia	28	56	6	0	4	7	0	0
Congo (Dem. Rep.)	0	7	0	0	3	89	0	0
Congo (Rep.)	0	96	0	0	0	4	0	0
Costa Rica	0	0	0	0	33	14	52	1
Cote d'Ivoire	0	8	21	0	2	69	0	0
Croatia	0	42	34	0	15	7	0	1
Cuba	0	39	7	0	0	54	0	0

	Coal [%]	Crude oil, NGL, Feedstocks, Non-crude oil [%]	Natural Gas [%]	Nuclear [%]	Hydro [%]	Biomass [%]	Geothermal [%]	Other [%]
Cyprus	0	0	0	0	0	20	0	80
Czech Republic	82	1	1	12	1	2	0	1
Denmark	0	63	29	0	0	3	0	4
Dominican Republic	0	0	0	0	6	94	0	0
Ecuador	0	90	1	0	3	6	0	0
Egypt	0	72	24	0	2	2	0	0
El Salvador	0	0	0	0	7	69	24	0
Eritrea	0	0	0	0	0	100	0	0
Estonia	77	0	0	0	0	18	0	4
Ethiopia	0	0	0	0	1	99	0	0
Finland	0	0	0	39	7	40	0	14
Former USSR	15	31	47	4	2	1	0	0
Former Yugoslavia	53	13	10	6	12	6	0	0
France	2	2	1	81	5	7	0	1
Gabon	0	94	0	0	0	5	0	0
Georgia	1	15	0	0	75	9	0	0
Germany	47	3	13	33	1	1	0	3
Ghana	0	0	0	0	6	94	0	0
Greece	84	0	0	0	4	9	0	2
Guatemala	0	28	0	0	5	67	0	0
Haiti	0	0	0	0	1	99	0	0
Honduras	0	0	0	0	10	90	0	0
Hong Kong	0	0	0	0	0	100	0	0
Hungary	26	15	23	32	0	3	0	1
Iceland	0	0	0	0	23	0	77	0
India	36	8	5	1	2	48	0	0
Indonesia	20	31	27	0	0	21	1	0
Iran	0	78	21	0	0	0	0	0
Iraq	0	97	3	0	0	0	0	0
Ireland	0	0	44	0	3	5	0	48
Israel	8	2	1	0	0	1	0	87
Italy	0	18	51	0	14	4	10	2
Jamaica	0	0	0	0	2	98	0	0
Japan	2	1	2	79	7	4	3	2
Jordan	0	1	76	0	0	1	0	22
Kazakhstan	40	47	12	0	1	0	0	0
Kenya	0	0	0	0	2	95	3	0
Korea	6	1	0	83	1	0	0	8
Korea, DPR	95	0	0	0	3	2	0	0
Kuwait	0	93	7	0	0	0	0	0
Kyrgyzstan	12	6	2	0	80	0	0	0
Latvia	0	0	0	0	16	79	0	5
Lebanon	0	0	0	0	18	78	0	4
Libya	0	93	7	0	0	0	0	0

	Coal [%]	Crude oil, NGL, Feedstocks, Non-crude oil [%]	Natural Gas [%]	Nuclear [%]	Hydro [%]	Biomass [%]	Geothermal [%]	Other [%]
Lithuania	0	7	0	74	1	18	0	1
Luxembourg	0	0	0	0	16	34	0	50
Macedonia	83	0	0	0	6	9	2	0
Malaysia	0	51	45	0	1	3	0	0
Mexico	2	75	14	1	1	4	2	0
Moldova	0	0	0	0	11	89	0	0
Morocco	12	2	5	0	12	70	0	0
Mozambique	0	0	0	0	8	92	0	0
Myanmar	0	3	28	0	0	68	0	0
Namibia	0	0	0	0	37	63	0	0
Nepal	0	0	0	0	1	99	0	0
Netherlands	0	4	92	2	0	0	0	2
New Zealand	15	15	32	0	13	6	17	2
Nicaragua	0	0	0	0	2	92	6	0
Nigeria	0	56	3	0	0	40	0	0
Norway	0	73	21	0	5	1	0	0
Oman	0	89	11	0	0	0	0	0
Pakistan	4	7	32	0	4	53	0	0
Panama	0	0	0	0	34	66	0	0
Paraguay	0	0	0	0	66	34	0	0
Peru	0	46	6	0	11	38	0	0
Philippines	2	0	0	0	3	48	46	0
Poland	91	1	4	0	0	4	0	1
Portugal	0	0	0	0	32	60	4	4
Qatar	0	63	37	0	0	0	0	0
Romania	17	22	40	5	6	10	0	0
Russia	12	32	50	3	1	1	0	0
Saudi Arabia	0	91	9	0	0	0	0	0
Senegal	0	0	0	0	0	100	0	0
Singapore	0	0	0	0	0	0	0	100
Slovak Republic	20	1	3	67	8	1	0	0
Slovenia	40	0	0	41	11	8	0	0
South Africa	88	0	1	2	0	9	0	0
Spain	28	1	0	50	6	12	0	2
Sri Lanka	0	0	0	0	8	92	0	0
Sudan	0	21	0	0	1	79	0	0
Sweden	0	0	0	55	18	23	0	3
Switzerland	0	0	0	57	29	4	1	9
Syria	0	84	13	0	2	0	0	0
Tajikistan	1	1	2	0	96	0	0	0
Tanzania	0	0	0	0	1	99	0	0
Thailand	14	11	39	0	1	36	0	0
Togo	0	0	0	0	0	100	0	0
Trinidad and Tobago	0	44	56	0	0	0	0	0

	Coal [%]	Crude oil, NGL, Feedstocks, Non-crude oil [%]	Natural Gas [%]	Nuclear [%]	Hydro [%]	Biomass [%]	Geothermal [%]	Other [%]
Tunisia	0	58	24	0	0	17	0	0
Turkey	49	11	2	0	11	25	1	0
Turkmenistan	0	29	71	0	0	0	0	0
Ukraine	52	5	18	23	1	0	0	0
United Arab Emirates	0	78	22	0	0	0	0	0
United Kingdom	8	51	32	9	0	0	0	0
United States	33	22	26	12	1	4	1	1
Uruguay	0	0	0	0	49	51	0	0
Uzbekistan	2	15	82	0	1	0	0	0
Venezuela	2	81	12	0	2	0	0	2
Vietnam	11	34	2	0	3	50	0	0
Yemen	0	100	0	0	0	0	0	0
Yugoslavia (Fed. Rep.)	70	10	6	0	11	2	0	0
Zambia	2	0	0	0	12	86	0	0
Zimbabwe	31	0	0	0	3	66	0	0

Tab. 2.2: Energy production by fuel type in 1999 as a percentage of total energy production

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Natural Gas Liquids (NGLs) are the liquid or liquefied hydrocarbons produced in the manufacture, purification and stabilisation of natural gas. These are those portions of natural gas which are recovered as liquids in separators, field facilities, or gas processing plants. NGLs include but are not limited to ethane, propane, butane, pentane, natural gasoline and condensate. They may also include small quantities of non-hydrocarbons.

A refinery feedstock is a product or a combination of products derived from crude oil and destined for further processing other than blending in the refining industry. It is transformed into one or more components and/or finished products. This definition covers those finished products imported for refinery intake and those returned from the petrochemical industry to the refining industry.

2.3 Final Energy Consumption by Sectors

	Total Industry Sector [%]	Total Transport Sector [%]	Agriculture [%]	Commercial and Public Services [%]	Residential [%]	Other [%]
Albania	20	29	0	1	35	14
Algeria	25	21	0	0	32	22
Angola	12	12	0	5	70	1
Argentina	32	32	6	7	21	2
Armenia	49	6	6	2	18	19
Australia	35	39	2	7	13	4
Austria	25	27	3	11	25	9
Azerbaijan	29	10	3	1	49	8
Bahrain	55	29	0	4	11	0
Bangladesh	25	8	3	1	60	3
Belarus	39	13	5	1	33	9
Belgium	39	24	2	9	23	3
Benin	4	20	0	9	67	0
Bolivia	23	36	0	2	29	10
Bosnia and Herzegovina	5	33	0	0	14	48
Brazil	42	32	5	5	13	3
Brunei	13	52	0	21	10	5
Bulgaria	44	21	3	7	22	2
Cameroon	17	11	0	1	71	1
Canada	36	29	2	13	16	3
Chile	36	34	1	3	26	0
China	42	9	4	2	38	4
Chinese Taipei	50	27	2	5	10	6
Colombia	30	31	7	5	19	8
Congo (Dem. Rep.)	21	2	0	0	75	2
Congo (Rep.)	2	20	0	0	78	0
Costa Rica	21	51	4	8	13	2
Cote d'Ivoire	8	15	2	12	61	2
Croatia	31	26	4	8	28	3
Cuba	66	11	3	3	8	9
Cyprus	25	50	0	6	12	6
Czech Republic	42	17	2	12	22	5
Denmark	18	32	7	12	28	3
Dominican Republic	19	40	2	0	39	0
Ecuador	19	37	5	6	28	4
Egypt	44	22	1	3	24	7
El Salvador	23	30	0	3	43	1
Eritrea	4	14	0	12	69	1
Estonia	26	19	2	10	40	2
Ethiopia	2	3	0	0	2	93
Finland	47	18	3	6	21	6

	Total Industry Sector [%]	Total Transport Sector [%]	Agriculture [%]	Commercial and Public Services [%]	Residential [%]	Other [%]
France	27	31	2	13	23	4
Gabon	22	18	0	1	54	5
Georgia	16	24	4	15	28	13
Germany	29	28	1	10	26	5
Ghana	13	13	1	0	72	1
Greece	23	40	6	7	23	2
Guatemala	13	25	1	4	57	0
Haiti	16	14	0	3	66	1
Honduras	20	22	0	5	53	0
Hong Kong	17	57	0	17	8	1
Hungary	24	19	4	16	32	4
Iceland	30	16	15	5	27	7
India	27	12	3	1	56	1
Indonesia	18	19	2	1	59	1
Iran	30	28	5	7	26	5
Iraq	30	43	0	0	11	16
Ireland	24	36	2	14	23	2
Israel	24	32	1	8	17	18
Italy	32	32	2	4	27	3
Jamaica	26	42	11	6	14	0
Japan	39	27	3	13	15	3
Jordan	22	38	2	7	23	6
Kazakhstan	54	12	5	0	2	26
Kenya	11	12	7	1	69	1
Korea	44	22	3	15	11	5
Korea, DPR	89	7	0	0	1	3
Kuwait	33	19	0	0	23	25
Kyrgyzstan	22	15	14	0	9	40
Latvia	22	21	3	19	33	2
Lebanon	25	41	0	3	23	9
Libya	33	38	0	0	10	20
Lithuania	27	26	2	11	30	3
Luxembourg	27	51	0	2	18	1
Macedonia	29	24	4	11	30	2
Malaysia	40	40	0	7	11	2
Malta	8	60	0	7	23	3
Mexico	36	39	3	4	18	1
Moldova	18	11	8	23	33	7
Morocco	27	11	1	2	24	35
Mozambique	23	4	0	0	72	0
Myanmar	8	10	0	1	81	0
Namibia	6	42	13	0	16	23
Nepal	6	3	0	2	89	0
Netherlands	33	24	7	8	18	10
New Zealand	40	37	3	7	11	3
Nicaragua	17	23	1	4	53	2

	Total Industry Sector [%]	Total Transport Sector [%]	Agriculture [%]	Commercial and Public Services [%]	Residential [%]	Other [%]
Nigeria	11	7	0	0	79	2
Norway	37	25	4	11	19	4
Oman	48	23	0	4	9	16
Pakistan	27	17	1	2	52	1
Panama	20	36	0	12	30	2
Paraguay	35	30	0	2	33	0
Peru	25	27	4	3	40	1
Philippines	30	33	2	9	21	4
Poland	32	18	9	8	31	2
Portugal	39	35	4	7	12	4
Qatar	81	12	0	1	0	6
Romania	40	14	2	3	37	5
Russia	34	20	4	6	33	3
Saudi Arabia	24	21	0	4	9	42
Senegal	17	24	3	1	55	1
Singapore	39	43	0	8	5	5
Slovak Republic	45	11	2	15	18	8
Slovenia	29	29	0	16	24	2
South Africa	46	24	3	4	21	2
Spain	32	39	3	7	14	5
Sri Lanka	23	25	0	3	45	4
Sudan	6	15	0	2	76	1
Sweden	36	23	1	14	23	3
Switzerland	20	32	1	16	27	3
Syria	28	11	0	0	10	51
Tajikistan	16	36	13	1	9	25
Tanzania	12	2	3	0	79	4
Thailand	37	37	4	5	16	1
Togo	12	25	0	2	48	13
Trinidad and Tobago	84	12	0	1	2	0
Tunisia	24	27	6	7	32	3
Turkey	32	23	6	2	32	5
Turkmenistan	2	6	2	0	1	90
Ukraine	44	8	4	10	29	4
United Arab Emirates	71	15	0	7	6	0
United Kingdom	26	32	1	10	27	4
United States	24	41	1	12	17	4
Uruguay	21	34	8	7	27	4
USSR (Former)	35	17	4	7	31	6
Uzbekistan	25	11	7	8	39	10
Venezuela	45	34	0	6	10	5
Vietnam	10	14	2	3	71	0
Yemen	7	59	0	0	25	10
Yugoslavia (Fed. Rep.)	31	19	0	0	16	34
Zambia	24	5	1	2	67	2

	Total Industry Sector [%]	Total Transport Sector [%]	Agriculture [%]	Commercial and Public Services [%]	Residential [%]	Other [%]
Zimbabwe	13	10	9	3	62	3

Tab. 2.3: Final energy consumption by sector in 1999 as a percentage of total final energy consumption

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

2.4 Total Final Energy Consumption

	Total final energy consumption [ktoe]						Average % change per year (between 1994 to 1999)
	1994	1995	1996	1997	1998	1999	
Albania	832	767	836	666	751	719	-2
Algeria	14264	14047	13910	13955	14169	15494	2
Angola	5351	5316	5481	5641	5538	5864	2
Argentina	37513	39074	40348	42058	43749	44003	3
Armenia	1127	1173	748	960	989	969	-1
Australia	61899	64172	66268	67750	69024	69874	2
Austria	22068	22127	23362	23588	24004	24201	2
Azerbaijan	10919	9020	7603	6658	6639	6533	-9
Bahrain	2649	2792	2867	2840	2996	2917	2
Bangladesh	12418	13768	13610	14214	14701	14793	4
Belarus	19208	18476	18831	18955	19140	18322	-1
Belgium	36315	36622	40226	40394	41181	41262	3
Benin	1514	1546	1253	1387	1441	1493	0
Bolivia	2719	3012	2972	3448	3552	3405	5
Bosnia and Herzegovina	1104	1132	1167	1201	1237	1275	3
Brazil	124955	130302	136950	144631	149699	152203	4
Brunei	563	619	679	744	690	657	3
Bulgaria	11702	12325	12691	11229	10935	9716	-3
Cameroon	5180	5265	5382	5560	5721	5760	2
Canada	172453	176097	182827	185073	180681	186134	2
Chile	13393	14495	15591	17264	17017	17553	6
China	772801	795753	829535	787907	784419	753866	0
Chinese Taipei	40077	41568	43710	44738	47278	49316	4
Colombia	24055	25539	26119	25254	24821	23278	-1
Congo (Dem. Rep.)	11737	12084	12428	12805	13196	13537	3
Congo (Rep.)	599	588	590	548	551	527	-2
Costa Rica	2034	2065	2087	2057	2147	2292	2
Cote d'Ivoire	3159	3372	3501	3640	3761	3870	4
Croatia	5204	5345	5408	5887	5825	6135	3
Cuba	8898	8651	9562	9534	8931	9531	2
Cyprus	1421	1492	1546	1555	1632	1688	4
Czech Republic	27233	28546	26533	25897	25338	24823	-2
Denmark	15118	15525	16258	15761	15672	15641	1
Dominican Republic	3557	3755	4101	4465	4825	5190	8
Ecuador	5934	6464	6462	6727	6700	6696	3

	Total final energy consumption [ktoe]						Average % change per year (between 1994 to 1999)
	1994	1995	1996	1997	1998	1999	
Egypt	20931	22849	23278	24873	27360	27670	6
El Salvador	2536	2681	2643	2817	2951	3075	4
Eritrea	720	756	797	832	530	548	-4
Estonia	3068	2738	3163	3093	2853	2516	-3
Ethiopia	15237	15733	16168	16578	17156	17540	3
Finland	23518	22694	23255	24202	25016	25221	1
France	153512	156662	162267	162112	167533	169741	2
Gabon	1269	1329	1378	1470	1502	1462	3
Georgia	2740	1635	2248	2394	2245	2190	-1
Germany	235338	239108	249261	245325	244501	239742	0
Ghana	5031	5258	5484	5523	5320	5433	2
Gibraltar	95	93	93	93	93	93	0
Greece	15550	16074	17554	18041	19083	18994	4
Guatemala	4380	4730	4781	4946	5196	5265	4
Haiti	1138	1379	1596	1693	1756	1765	9
Honduras	2545	2689	2657	2861	2996	2987	3
Hong Kong, China	9927	9953	9977	10236	12291	13647	7
Hungary	17148	17333	17676	17000	17218	17095	0
Iceland	1787	1790	1855	1887	1976	2146	4
India	327472	343724	354101	355786	357423	360903	2
Indonesia	89471	93455	99438	101896	101592	106634	4
Iran	65829	68565	74411	78389	79756	81853	4
Iraq	20429	20267	19998	20495	21113	21010	1
Ireland	8412	8457	8813	9344	9970	10590	5
Israel	9722	10811	11392	11714	11875	12209	5
Italy	118238	123214	124302	125622	128891	131780	2
Jamaica	1815	1838	1938	1986	2171	2196	4
Japan	319087	329066	335862	339585	335430	341989	1
Jordan	3004	3168	3275	3407	3406	3480	3
Kazakhstan	31326	30950	26511	23653	22472	19928	-9
Kenya	9830	10006	10265	10338	10501	10590	2
Korea	99583	107654	115775	123100	111290	125042	5
Korea, DPR	47636	47163	46650	46143	43898	44337	-1
Kuwait	12193	11853	13090	13465	14562	13266	2
Kyrgyzstan	2468	1894	2127	1970	2377	1922	-3
Latvia	3696	3065	3544	3808	3576	3320	-1
Lebanon	3171	3722	3720	4142	3843	3880	4
Libya	8476	8974	9194	9504	9699	9859	3
Lithuania	4929	4973	4874	5075	5069	4672	-1
Luxembourg	3279	3037	3151	3216	3255	3434	1
Macedonia (Former Yug. Rep.)	1587	1551	1902	1741	1660	1690	2
Malaysia	20473	23268	25351	27448	27013	28412	7

	Total final energy consumption [ktoe]						Average % change per year (between 1994 to 1999)
	1994	1995	1996	1997	1998	1999	
Malta	432	444	518	561	549	571	6
Mexico	96897	95916	94052	94890	94612	93986	-1
Moldova	3067	2985	3162	3159	2710	1940	-8
Morocco	6586	6560	6987	7270	7389	8077	4
Mozambique	6874	6789	6740	6778	6834	6954	0
Myanmar	10152	10503	10482	10895	10990	11435	2
Namibia	846	969	1007	1057	1066	1084	5
Nepal	6793	7054	7314	7563	7779	7970	3
Netherlands	54534	56816	59277	58048	57963	57895	1
Netherlands Antilles	886	893	886	871	899	888	0
New Zealand	11188	11753	12182	12313	12377	13003	3
Nicaragua	1722	1773	1896	2037	2028	2156	5
Nigeria	70527	73306	76238	78927	80251	81537	3
Norway	18549	19100	19513	19431	20129	20331	2
Oman	3267	3246	3111	3274	3764	4579	7
Pakistan	42962	44246	46750	47125	48289	49978	3
Panama	1495	1556	1642	1698	1838	1845	4
Paraguay	3379	3766	4082	4251	4055	3891	3
Peru	10439	11570	12029	12292	12364	12598	4
Philippines	24078	24333	24568	24381	23990	25151	1
Poland	63371	65000	68881	67625	63127	61655	0
Portugal	14043	14453	15126	15916	17170	17806	5
Qatar	6923	7057	7300	7912	8031	7877	3
Romania	26054	27049	32759	29555	26835	23741	-1
Russia	485633	464851	419240	401686	394084	410369	-3
Saudi Arabia	49544	49550	53079	56034	59649	61180	4
Senegal	1796	1893	1984	2085	2198	2313	5
Singapore	8079	8666	9373	10018	10070	10158	5
Slovak Republic	12175	12229	13079	12684	12617	12920	1
Slovenia	3866	4119	4585	4663	4573	4635	4
South Africa	49189	52934	54332	56141	57169	55685	3
Spain	67959	71135	71693	75790	80508	83184	4
Sri Lanka	5625	5687	6368	6972	6997	7470	6
Sudan	5595	5486	7310	7761	7871	8181	9
Sweden	34401	35253	36290	35546	35330	35423	1
Switzerland	19717	20213	20692	20314	21034	21415	2
Syria	10546	11113	11364	12426	13916	14316	6
Tajikistan	2937	2936	3100	2741	2872	2956	0
Tanzania	12255	12489	12705	12927	13257	13589	2
Thailand	40937	45950	50655	51264	46900	49903	4
Togo	347	407	498	478	508	517	9
Trinidad and Tobago	3495	3630	3895	4022	4700	5211	8

	Total final energy consumption [ktoe]						Average % change per year (between 1994 to 1999)
	1994	1995	1996	1997	1998	1999	
Tunisia	4897	5008	5235	5392	5665	5867	4
Turkey	42853	47742	51766	53615	53740	52001	4
Turkmenistan	8763	8806	7816	7726	7271	8550	0
Ukraine	103197	104446	94514	91074	89237	88482	-3
United Arab Emirates	15668	15608	18851	17509	17757	17501	3
United Kingdom	153000	152235	161119	156959	157879	159785	1
United States	1367078	1389342	1433534	1439225	1431549	1475505	2
Uruguay	2281	2263	2406	2536	2613	2692	3
USSR (Former)	715684	689346	628545	604416	598749	609588	-3
Uzbekistan	32605	31398	31065	31463	37212	36917	3
Venezuela	31572	34045	35849	35298	36698	34784	2
Vietnam	26352	28182	30033	30979	31221	32481	4
Yemen	2323	2591	2584	2658	2666	2449	1
Yugoslavia (Fed. Rep.)	6081	6680	8840	10114	10033	8539	8
Zambia	4281	4377	4437	4525	4598	4689	2
Zimbabwe	7869	8191	8378	8401	8500	8619	2

Tab. 2.4: Total final energy consumption in ktoe

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

The following table ranks the analyzed countries according their average annual growth rate in total final energy consumption between 1994 and 1999:

Country	Average % change in energy consumption per year (between 1994 to 1999)
Haiti	9
Togo	9
Sudan	9
Trinidad and Tobago	8
Yugoslavia (Fed. Rep.)	8
Dominican Republic	8
Oman	7
Malaysia	7
Hong Kong, China	7
Syria	6
Sri Lanka	6
Malta	6
Egypt	6
Chile	6
Namibia	5
Senegal	5
Korea	5
Portugal	5
Bolivia	5
Singapore	5
Ireland	5
Israel	5
Nicaragua	5
Lebanon	4
Iran	4
Saudi Arabia	4
Panama	4
Thailand	4
Vietnam	4
Chinese Taipei	4
Morocco	4
Cote d'Ivoire	4
Spain	4
Greece	4
Turkey	4
Brazil	4
El Salvador	4
Jamaica	4

Country	Average % change in energy consumption per year (between 1994 to 1999)
Peru	4
Slovenia	4
Guatemala	4
Iceland	4
Tunisia	4
Bangladesh	4
Indonesia	4
Cyprus	4
Brunei	3
Croatia	3
Uruguay	3
Honduras	3
Argentina	3
Nepal	3
Pakistan	3
Libya	3
New Zealand	3
Paraguay	3
Jordan	3
Nigeria	3
Bosnia and Herzegovina	3
Gabon	3
Congo (Dem. Rep.)	3
Ethiopia	3
Uzbekistan	3
Qatar	3
United Arab Emirates	3
Belgium	3
South Africa	3
Ecuador	3
Australia	2
Costa Rica	2
Myanmar	2
Italy	2
Cameroon	2
Tanzania	2
Venezuela	2
France	2
Bahrain	2
India	2
Kuwait	2
Angola	2
Austria	2

Country	Average % change in energy consumption per year (between 1994 to 1999)
Norway	2
Zimbabwe	2
Zambia	2
Macedonia (Former Yug. Rep.)	2
Algeria	2
Switzerland	2
Ghana	2
Cuba	2
Canada	2
United States	2
Kenya	2
Finland	1
Japan	1
Yemen	1
Slovak Republic	1
Netherlands	1
Luxembourg	1
United Kingdom	1
Philippines	1
Denmark	1
Sweden	1
Iraq	1
Germany	0
Tajikistan	0
Benin	0
Mozambique	0
Netherlands Antilles	0
Hungary	0
Turkmenistan	0
Gibraltar	0
China	0
Poland	0
Colombia	-1
Armenia	-1
Mexico	-1
Belarus	-1
Lithuania	-1
Georgia	-1
Romania	-1
Korea, DPR	-1
Latvia	-1

Country	Average % change in energy consumption per year (between 1994 to 1999)
Czech Republic	-2
Albania	-2
Congo (Rep.)	-2
Ukraine	-3
USSR (Former)	-3
Russia	-3
Kyrgyzstan	-3
Bulgaria	-3
Estonia	-3
Eritrea	-4
Moldova	-8
Kazakhstan	-9
Azerbaijan	-9

Tab. 2.5: Average annual change in total final energy consumption between 1994 and 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

2.5 Aggregate Energy Intensity

On a national level, aggregate energy intensity (total final energy consumption divided by GDP) is often used as a broad indicator of aggregate energy efficiency. Aggregate energy intensity is somehow inversely related to aggregate energy efficiency. However, the relationship is not as simple as it looks on the first sight. The problem is that aggregate energy intensity not only depends on the energy efficiency of the various sectors of the economy, but also on the structure of the economy itself (i.e. the shares of industry, services, transport, agriculture in GDP), the structure of the various economic sectors (e.g. the shares of energy-intensive and less energy-intensive manufacturing sectors), the climate, the population density, behavior, capacity utilization, etc.

Pure energy efficiency (i.e. physical or monetary output per unit energy consumed) is only directly measurable at the greatest level of disaggregation (e.g. a machine). To get a more or less true picture of the energy efficiency of a whole economy one would have to collect and assemble all individual data, which is in practice an impossible task. A reasonable compromise is to determine the energy intensity at a sectoral level, such as the manufacturing, transportation, residential, or commercial and service sector, or preferably at a sub-sectoral level, such as e.g. the chemical industry. This will be done in the following chapters. Nevertheless, bearing in mind the limited information value of aggregate energy intensity, the following pages show aggregate energy intensity for more than 100 countries.

Aggregate energy intensity is here defined as the ratio between total final energy consumption (in toe) and GDP (in constant 1995 US \$ using purchasing power parities).

Data source:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

GDP is expressed in constant 1995 US dollars using purchasing power parities:

The use of *constant 1995 US dollars* - versus *current US dollars* - to express the GDP of various countries allows analyzing trends in energy intensity over time within one country, leaving out the effect of price inflation.

The use of *purchasing power parities (PPPs)* - versus official exchange rates - to convert constant national currency into constant US dollars allows comparing the GDP and, thus, the energy intensity, in different countries at the same time, leaving out the difference in price levels among the analyzed countries.

Purchasing power parities are the rates of currency conversion that equalize the purchasing power of different currencies. A given sum of money, when converted into different currencies at the PPP rates, buys the same basket of goods and services in all

countries. In other words, PPPs are the rates of currency conversion, which eliminate the differences in price levels between different countries.

The usual conversion of GDP of different countries at exchange rates does not give a true comparison of the actual differences in economic activity because of sometimes-abrupt fluctuations of the exchange rate and, secondly, differences in the general price level.

First, exchange rates vary from day to day and sometimes change abruptly - perhaps because of speculation against a currency or because of changes in interest rates. If GDP is converted into a common currency using exchange rates, the size of a country's economy can also appear to vary from day to day and undergo abrupt shifts for reasons that have nothing to do with the actual levels of economic activity in that country.

Secondly, exchange rates do not simply reflect the relative prices of goods and services produced in a country - they are affected by the relative prices of tradable goods and by factors such as interest rates, financial flows etc.

Using PPPs – instead of exchange rates - for international comparisons of energy intensity (expressed as energy consumption per GDP) has the effect of narrowing the difference between industrialized and less developed countries. This is because the use of PPPs increases the value of economic output – and, therefore, decreases the energy intensity – especially for developing countries.

PPP conversion factors used in this work:

	Conversion factor between GDP in US\$ at 1995 prices and exchange rates and GDP in US\$ at 1995 prices and PPPs
ALBANIA	3.53
ALGERIA	3.13
ANGOLA	1.74
ARGENTINA	1.44
ARMENIA	2.47
AUSTRALIA	1.05
AUSTRIA	0.73
AZERBAIJAN	5.16
BAHRAIN	1.42
BANGLADESH	3.96
BELARUS	2.62
BELGIUM	0.80
BENIN	2.26
BOLIVIA	2.40
BRAZIL	1.50
BRUNEI	0.61
BULGARIA	3.29
CAMEROON	2.35
CANADA	1.16
CHILE	1.65
CHINA	4.52
COLOMBIA	2.46
CONGO	1.02
CONGO REP	6.88
COSTA RICA	1.94
COTE D'IVOIRE	2.09
CUBA	1.21
CYPRUS	1.38
CZECH REP.	2.45
DENMARK	0.67
DOMINICAN REP.	2.79
ECUADOR	2.01
EGYPT	2.79
EL SALVADOR	2.36
ERITREA	4.79
ESTONIA	1.99
ETHIOPIA	5.42
FINLAND	0.74
FORMER YUGOSLAVIA	1.98
FRANCE	0.77
GABON	1.36
GEORGIA	5.70
GERMANY	0.71
GHANA	4.43

	Conversion factor between GDP in US\$ at 1995 prices and exchange rates and GDP in US\$ at 1995 prices and PPPs
GIBRALTAR	0.92
GREECE	1.11
GUATEMALA	2.29
HAITI	3.82
HONDURAS	3.40
HONGKONG	0.96
HUNGARY	2.08
ICELAND	0.85
INDIA	4.82
INDONESIA	2.74
IRAN	3.36
IRAQ	0.40
IRELAND	0.98
ISRAEL	1.08
ITALY	1.05
JAMAICA	2.07
JAPAN	0.55
JORDAN	2.37
KAZAKHSTAN	3.41
KENYA	3.00
KOREA (REP.)	1.25
KUWAIT	1.08
KYRGYZSTAN	2.80
LATVIA	2.47
LEBANON	1.43
LIBYA	0.83
LITHUANIA	3.19
LUXEMBOURG	0.76
MALAYSIA	1.70
MALTA	1.50
MEXICO	2.17
MOLDOVA	3.31
MOROCCO	2.45
MOZAMBIQUE	4.26
MYANMAR	33.49
NAMIBIA	2.45
NANTILLES	0.98
NEPAL	5.41
NETHERLAND	0.79
NEW ZEALAND	1.04
NICARAGUA	5.20
NIGERIA	3.20
NORWAY	0.69
OMAN	3.01
PAKISTAN	3.46
PANAMA	1.69

	Conversion factor between GDP in US\$ at 1995 prices and exchange rates and GDP in US\$ at 1995 prices and PPPs
PARAGUAY	2.41
PERU	1.90
PHILIPPINE	3.29
POLAND	2.13
PORTUGAL	1.27
QATAR	1.34
ROMANIA	4.56
RUSSIA	3.10
SAUDIARABI	1.55
SENEGAL	2.36
SINGAPORE	0.80
SLOVAK REP.	2.50
SOUTH AFRIC	2.19
SPAIN	1.02
SRI LANKA	3.85
SUDAN	1.96
SWEDEN	0.73
SWITZERLAND	0.59
SYRIA	2.64
TAIPEI	1.49
TAJIKISTAN	5.17
TANZANIA	2.95
THAILAND	2.14
TOGO	4.22
TRINIDAD & TOBAGO	1.64
TUNISIA	2.44
TURKEY	2.05
TURKMENISTAN	3.31
UAE	1.07
UK	0.97
UKRAINE	3.89
URUGUAY	1.38
USA	1.00
UZBEKISTAN	2.83
VENEZUELA	1.66
VIETNAM	5.34
YEMEN	2.65
ZAMBIA	1.91
ZIMBABWE	3.86

Tab. 2.6: PPP conversion factors used in this work

Source: International Energy Agency, Energy Balances of OECD and non-OECD countries, 2001.

Energy Intensity (total final energy consumption divided by GDP converted into constant 1995 US dollars using PPPs):

List of countries ranked from highest to lowest energy intensity in 1999:

Country	Energy intensity in 1999 (Total final energy consumption [toe] per GDP [mill 1995 US \$ PPP])	Average % change of energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in GDP per year between 1994 and 1999
Nigeria	823	0	3	2
Tanzania	744	-2	2	4
Iraq	730	-8	1	10
Uzbekistan	704	0	3	2
Zambia	638	0	2	2
Kuwait	559	6	2	-3
Turkmenistan	558	1	0	0
Ukraine	544	3	-3	-5
Qatar	531	-4	3	7
Angola	523	-5	2	8
Trinidad and Tobago	497	4	8	4
Sudan	479	1	9	9
Mozambique	477	-7	0	8
Ethiopia	459	-2	3	5
Congo (Dem. Rep.)	423	7	3	-3
Russia	409	-2	-3	-2
Libya	369	1	3	2
Kenya	357	-1	2	3
United Arab Emirates	351	0	3	3
Azerbaijan	346	-12	-9	3
Bahrain	332	-1	2	3
Cuba	304	-2	2	4
Iceland	300	0	4	4
Tajikistan	295	1	0	0
Saudi Arabia	291	3	4	1
Kazakhstan	287	-7	-9	-1
Nepal	284	-1	3	4
Syria	279	2	6	5
Venezuela	274	2	2	1
Belarus	274	-3	-1	3
Benin	269	-5	0	5
Zimbabwe	267	-1	2	3
Cameroon	255	-2	2	5
Bulgaria	254	-1	-3	-2
Iran	243	1	4	3
Jamaica	242	5	4	-1
Canada	242	-2	2	3

Country	Energy intensity in 1999 (Total final energy consumption [toe] per GDP [mill 1995 US \$ PPP])	Average % change of energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in GDP per year between 1994 and 1999
Slovak Republic	235	-4	1	5
Latvia	235	-4	-1	3
Vietnam	230	-3	4	8
Moldova	222	-5	-8	-3
Estonia	221	-8	-3	4
Lebanon	218	1	4	4
Congo (Rep.)	216	-2	-2	0
Finland	216	-3	1	5
Pakistan	211	0	3	3
Gabon	204	0	3	3
Honduras	202	1	3	3
Lithuania	201	-4	-1	3
Luxembourg	199	-4	1	5
Gibraltar	198	-3	0	3
Indonesia	196	2	4	2
Jordan	193	0	3	4
Czech Republic	193	-3	-2	1
Brunei	191	1	3	2
New Zealand	191	0	3	3
Yemen	189	-4	1	6
Ecuador	189	2	3	0
Poland	184	-6	0	6
Romania	183	-1	-1	-1
Bolivia	183	1	5	4
Sweden	181	-2	1	3
Senegal	179	0	5	5
Nicaragua	179	0	5	5
Norway	177	-1	2	3
Korea	176	0	5	5
Paraguay	174	2	3	1
China	173	-8	0	9
United States	172	-2	2	4
Belgium	169	0	3	2
India	167	-4	2	6
Kyrgyzstan	166	-7	-3	3
Eritrea	165	-8	-4	4
Malaysia	162	2	7	5
Haiti	160	6	9	3
Ghana	159	-3	2	4
Hungary	159	-3	0	3
Georgia	155	-7	-1	6
South Africa	154	0	3	2
Netherlands	153	-2	1	3

Country	Energy intensity in 1999 (Total final energy consumption [toe] per GDP [mill 1995 US \$ PPP])	Average % change of energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in GDP per year between 1994 and 1999
Cote d'Ivoire	152	-1	4	6
Australia	149	-2	2	4
Thailand	142	3	4	1
Chile	138	0	6	6
Brazil	135	2	4	2
Guatemala	134	0	4	4
Egypt	133	0	6	5
Turkey	133	0	4	4
United Kingdom	131	-2	1	3
Germany	130	-1	0	2
Greece	130	1	4	3
France	129	0	2	2
Austria	128	0	2	2
Sri Lanka	125	1	6	5
Namibia	124	2	5	3
Mexico	124	-3	-1	3
Singapore	123	-1	5	6
Cyprus	121	0	4	4
El Salvador	121	0	4	4
Spain	121	1	4	3
Panama	120	1	4	3
Denmark	118	-2	1	3
Japan	115	0	1	1
Dominican Republic	115	1	8	7
Ireland	114	-4	5	9
Portugal	114	1	5	3
Israel	113	1	5	4
Oman	113	5	7	3
Armenia	112	-5	-1	5
Peru	112	0	4	4
Switzerland	112	0	2	1
Italy	107	0	2	2
Tunisia	106	-1	4	5
Algeria	105	-2	2	3
Argentina	103	1	3	2
Colombia	101	-2	-1	1
Malta	99	1	6	5
Hong Kong, China	95	5	7	2
Uruguay	95	1	3	2
Philippines	91	-3	1	4
Morocco	86	3	4	2
Costa Rica	83	-3	2	5
Togo	82	4	9	4

Country	Energy intensity in 1999 (Total final energy consumption [toe] per GDP [mill 1995 US \$ PPP])	Average % change of energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in GDP per year between 1994 and 1999
Bangladesh	81	-1	4	5
Albania	70	-8	-2	6
Myanmar	69	-3	2	6

Tab. 2.7: List of countries ranked from highest to lowest energy intensity in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Shortcomings of Tab. 2.7:

- Aggregated energy intensity (total final energy consumption per GDP) is not suitable as an indicator for aggregated energy efficiency, because the aggregated energy intensity depends on a large number of factors besides energy efficiency (structure of the economy, population density, climate, behavior, etc.).
- Although GDP is expressed in constant dollars using purchasing power parities, there are still some unsolved problems in comparing GDP between different countries, particularly industrialized and developing countries. First, purchasing power parities are usually calculated for an American basket of goods, which is not always representative for developing countries. Secondly, in many developing countries there is a high share of GDP not accounted for in the official statistics. The contribution of the informal economy to GDP was estimated by the International Labour Organization (ILO) [2002] to range between 25% and 60% for developing countries in Asia, South America, and Africa. Examples of the share of the informal sector GDP to non-agricultural GDP are 45% for India, 31% for Indonesia, 32% for the Philippines, 17% for the Republic of Korea, 49% for Peru, 13% for Mexico, and 31% for Morocco (ILO, 2002).
- The change in aggregated energy intensity by time can be caused by a variety of different factors, such as change in energy use, change in economic activity, structural changes, changes in energy efficiency, changes in the quality of produced products, etc. Therefore, it should not be regarded as an indicator for energy efficiency improvements or deteriorations.

3. Risk Factors

The following table shows a risk rating of 186 countries reflecting the investment climate as seen by investors in each country. Risk values range from 1 (indicating lowest risk) to 9 (indicating highest risk).

Country	Political risk	Economic risk	Legal risk	Tax risk	Operational risk	Security risk	Overall risk	Overall risk rating
Afghanistan	9	9	9	9	9	9	9.00	Extreme
Albania	6	7	6	6	7	6	6.37	High
Algeria	7	6	5	4	7	8	6.22	High
Andorra	1	2	3	1	2	1	1.80	Negligible
Angola	7	7	6	6	7	6	6.62	High
Antigua and Barbuda	4	5	3	3	3	2	3.77	Moderate
Argentina	6	7	3	4	5	4	5.39	Significant
Armenia	6	6	5	5	6	5	5.62	Significant
Australia	2	2	1	2	2	2	1.88	Negligible
Austria	3	2	1	2	2	1	2.12	Negligible
Azerbaijan	6	5	6	5	7	6	5.74	Significant
Bahamas, The	2	3	2	1	2	3	2.30	Negligible
Bahrain	4	4	3	1	3	4	3.46	Moderate
Bangladesh	6	7	5	5	6	5	5.90	Significant
Barbados	1	4	1	2	3	2	2.51	Negligible
Belarus	6	7	8	7	6	5	6.66	High
Belgium	2	2	2	3	3	2	2.29	Negligible
Belize	3	4	4	3	5	3	3.66	Moderate
Benin	5	5	5	5	6	4	5.02	Significant
Bermuda	2	3	2	1	3	2	2.30	Negligible
Bhutan	5	6	4	5	6	2	5.04	Significant
Bolivia	4	4	3	3	5	4	3.85	Moderate
Bosnia and Herzegovina	7	7	7	7	7	7	7.00	Very high
Botswana	3	2	4	3	3	2	2.88	Low
Brazil	4	5	3	5	4	5	4.41	Medium
Brunei	3	4	1	1	4	1	2.87	Low
Bulgaria	4	4	5	5	5	5	4.53	Medium
Burkina Faso	6	6	5	6	6	3	5.63	Significant
Burundi	8	7	7	7	8	8	7.47	Very high
Cambodia	6	5	6	6	6	6	5.77	Significant
Cameroon	5	5	6	6	7	5	5.54	Significant
Canada	2	2	1	1	2	1	1.67	Negligible
Cape Verde	5	5	4	6	4	4	4.85	Medium
Cayman Islands	1	3	2	1	2	2	2.01	Negligible
Central African Republic	8	8	6	6	7	7	7.25	Very high
Chad	6	7	7	7	7	7	6.76	High
Chile	3	3	2	2	2	3	2.65	Low
China	5	4	6	5	6	5	5.05	Significant

Country	Political risk	Economic risk	Legal risk	Tax risk	Operational risk	Security risk	Overall risk	Overall risk rating
Colombia	6	6	5	4	7	7	5.83	Significant
Comoros	8	8	7	7	8	6	7.53	Very high
Congo, Dem. Rep.	7	8	8	9	8	8	7.92	Very high
Congo, Rep.	6	6	7	7	7	7	6.52	High
Costa Rica	3	4	3	3	4	3	3.38	Moderate
Cote d'Ivoire	7	5	4	4	3	7	5.39	Significant
Croatia	4	4	4	4	4	4	4.00	Medium
Cuba	6	6	6	5	6	3	5.63	Significant
Cyprus	4	2	1	1	3	4	2.79	Low
Czech Republic	3	4	3	3	3	3	3.28	Moderate
Denmark	2	2	1	3	2	1	2.00	Negligible
Djibouti	6	6	6	5	6	6	5.86	Significant
Dominica	3	4	3	2	4	1	3.15	Moderate
Dominican Republic	5	5	5	4	5	4	4.77	Medium
East Timor	7	7	6	6	8	5	6.65	High
Ecuador	6	7	6	5	5	5	5.95	Significant
Egypt, Arab Rep.	5	5	6	5	5	4	5.07	Significant
El Salvador	5	6	5	4	6	6	5.35	Significant
Equatorial Guinea	6	5	7	7	7	4	6.04	High
Eritrea	7	7	6	5	5	8	6.52	High
Estonia	4	4	4	3	3	4	3.77	Moderate
Ethiopia	6	5	5	5	5	7	5.49	Significant
Fiji	6	6	5	3	4	4	5.13	Significant
Finland	1	2	1	3	2	1	1.80	Negligible
France	2	2	1	2	3	3	2.13	Negligible
French Guiana	4	3	3	2	3	3	3.16	Moderate
Gabon	3	5	4	4	4	2	3.91	Moderate
Gambia, The	6	6	6	6	5	4	5.74	Significant
Georgia	6	6	5	5	7	6	5.83	Significant
Germany	1	2	2	2	2	2	1.80	Negligible
Ghana	4	6	4	4	5	3	4.60	Medium
Greece	2	3	3	3	3	3	2.78	Low
Grenada	4	4	4	3	3	4	3.77	Moderate
Guatemala	5	5	5	5	5	5	5.00	Significant
Guinea	7	7	7	7	7	7	7.00	Very high
Guinea-Bissau	7	8	6	6	7	8	7.10	Very high
Guyana	5	5	5	4	5	6	4.97	Medium
Haiti	7	7	6	5	6	7	6.49	High
Honduras	5	7	5	5	7	5	5.78	Significant
Hong Kong, China	4	2	3	2	2	2	2.78	Low
Hungary	3	3	3	3	3	4	3.11	Moderate
Iceland	1	2	2	2	2	1	1.72	Negligible
India	6	5	5	4	5	6	5.24	Significant
Indonesia	6	6	6	5	5	6	5.77	Significant

Country	Political risk	Economic risk	Legal risk	Tax risk	Operational risk	Security risk	Overall risk	Overall risk rating
Iran, Islamic Rep.	6	6	7	7	7	6	6.42	High
Iraq	9	8	8	8	8	8	8.26	Extreme
Ireland	2	2	1	1	3	1	1.82	Negligible
Israel	4	4	1	2	3	7	3.81	Moderate
Italy	2	2	3	3	3	3	2.55	Low
Jamaica	3	6	5	3	5	5	4.62	Medium
Japan	2	4	2	2	3	1	2.68	Low
Jordan	4	6	4	3	4	5	4.57	Medium
Kazakhstan	5	5	5	5	6	4	5.02	Significant
Kenya	6	5	6	4	7	7	5.73	Significant
Korea, Dem. Rep.	7	8	8	8	8	5	7.51	Very high
Korea, Rep.	4	3	2	3	4	2	3.19	Moderate
Kuwait	4	5	5	3	4	5	4.41	Medium
Kyrgyz Republic	6	6	5	5	6	6	5.72	Significant
Lao PDR	5	6	5	4	6	4	5.16	Significant
Latvia	4	4	4	4	4	4	4.00	Medium
Lebanon	5	5	4	4	6	6	4.95	Medium
Lesotho	6	5	4	4	5	6	5.11	Significant
Liberia	8	8	7	6	7	8	7.49	Very high
Libya	6	6	7	9	7	6	6.78	High
Liechtenstein	2	1	2	1	2	1	1.58	Negligible
Lithuania	3	3	4	4	4	4	3.54	Moderate
Luxembourg	1	1	1	2	2	1	1.32	Insignificant
Macao, China	3	4	3	3	4	4	3.49	Moderate
Macedonia, FYR	6	6	5	5	6	7	5.83	Significant
Madagascar	6	6	5	5	5	4	5.44	Significant
Malawi	5	5	5	5	5	3	4.84	Medium
Malaysia	4	4	3	2	2	3	3.35	Moderate
Maldives	3	3	1	1	3	1	2.41	Negligible
Mali	6	6	6	6	6	5	5.91	Significant
Malta	3	3	2	1	3	2	2.56	Low
Martinique	3	4	3	2	4	2	3.19	Moderate
Mauritania	5	6	6	4	6	3	5.25	Significant
Mauritius	3	3	3	1	3	1	2.65	Low
Mexico	4	4	4	3	5	5	4.09	Medium
Moldova	6	6	5	5	6	4	5.54	Significant
Morocco	4	3	6	4	5	3	4.18	Medium
Mozambique	6	6	6	4	7	6	5.86	Significant
Myanmar	7	6	7	6	7	6	6.52	High
Namibia	3	5	3	4	4	3	3.84	Moderate
Nepal	6	6	5	6	6	7	5.97	Significant
Netherlands	2	1	1	2	2	1	1.58	Negligible
New Zealand	2	3	1	3	2	1	2.29	Negligible
Nicaragua	6	7	5	5	6	5	5.90	Significant
Niger	6	7	6	6	6	7	6.37	High
Nigeria	5	6	7	7	8	7	6.42	High

Country	Political risk	Economic risk	Legal risk	Tax risk	Operational risk	Security risk	Overall risk	Overall risk rating
Norway	2	2	1	3	2	1	2.00	Negligible
Oman	4	4	5	3	4	2	3.89	Moderate
Pakistan	7	7	7	6	7	8	6.97	High
Palestinian Auth.	7	7	7	6	7	8	6.97	High
Panama	4	5	4	2	4	6	4.30	Medium
Papua New Guinea	6	6	4	4	6	7	5.59	Significant
Paraguay	6	6	6	5	6	5	5.77	Significant
Peru	5	5	4	4	5	6	4.84	Medium
Philippines	5	5	5	5	6	6	5.22	Significant
Poland	3	3	3	3	3	4	3.11	Moderate
Portugal	1	3	3	3	3	1	2.49	Negligible
Puerto Rico	4	3	2	2	2	3	2.96	Low
Qatar	3	4	4	4	4	1	3.57	Moderate
Romania	5	4	5	5	5	3	4.60	Medium
Russian Federation	5	5	5	5	6	6	5.22	Significant
Rwanda	7	6	7	6	8	7	6.73	High
Samoa	4	4	3	5	6	2	4.14	Medium
Sao Tome and Principe	5	6	4	5	5	3	4.98	Medium
Saudi Arabia	4	4	5	3	4	3	3.95	Moderate
Senegal	4	4	4	5	4	4	4.17	Medium
Seychelles	4	4	2	1	3	2	3.17	Moderate
Sierra Leone	7	7	7	7	7	8	7.11	Very high
Singapore	2	2	1	1	1	2	1.67	Negligible
Slovak Republic	3	4	3	4	3	2	3.36	Moderate
Slovenia	2	4	4	3	3	1	3.12	Moderate
Somalia	8	9	9	9	8	8	8.56	Extreme
South Africa	4	4	3	2	3	6	3.80	Moderate
Spain	1	2	2	2	3	4	2.22	Negligible
Sri Lanka	6	5	4	5	5	6	5.24	Significant
Sudan	8	8	8	7	8	8	7.86	Very high
Suriname	6	6	5	5	4	4	5.36	Significant
Swaziland	6	5	4	5	4	3	4.89	Medium
Sweden	2	2	1	3	2	1	2.00	Negligible
Switzerland	2	1	1	1	2	1	1.43	Insignificant
Syrian Arab Republic	5	5	5	6	6	4	5.18	Significant
Taiwan	4	3	2	4	3	3	3.32	Moderate
Tajikistan	7	6	6	6	7	7	6.47	High
Tanzania	5	7	6	6	7	4	5.98	Significant
Thailand	4	5	4	4	3	3	4.10	Medium
Togo	6	6	6	6	5	4	5.74	Significant
Trinidad and Tobago	3	3	3	3	4	4	3.22	Moderate
Tunisia	4	4	4	4	3	2	3.75	Moderate
Turkey	5	4	3	5	5	5	4.51	Medium

Country	Political risk	Economic risk	Legal risk	Tax risk	Operational risk	Security risk	Overall risk	Overall risk rating
Turkmenistan	7	7	7	6	6	5	6.58	High
Uganda	5	4	5	5	5	5	4.77	Medium
Ukraine	6	6	5	5	5	5	5.52	Significant
United Arab Emirates	2	2	4	1	3	2	2.42	Negligible
United Kingdom	1	2	1	1	1	4	1.80	Negligible
United States	2	2	1	1	2	4	2.07	Negligible
Uruguay	4	4	3	2	3	3	3.43	Moderate
Uzbekistan	6	7	7	5	7	6	6.39	High
Venezuela, RB	6	6	5	4	6	5	5.50	Significant
Vietnam	5	6	5	5	6	3	5.22	Significant
Yemen, Rep.	5	5	7	7	6	7	5.97	Significant
Yugoslavia, Fed. Rep.	7	8	6	5	7	7	6.87	High
Zambia	6	6	5	4	6	6	5.60	Significant
Zimbabwe	7	7	7	6	6	6	6.67	High

Tab. 3.1: Investment risk by country as of August 29, 2002. Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

Data source: World Markets Research Centre, London, UK.

Explanation of different risk factors:

Political risk: describes how well-established, stable and mature the political system is, how well the population and organized interests can represent themselves, whether the country is divided socially or politically, and the degree to which the country has achieved a political consensus with foreign states.

Economic risk: reflects macroeconomic fundamentals, such as growth rate, inflation, and unemployment, describes the degree of market orientation, whether there is a coherent and consistent economic policy, and how stable and diversified the economy is.

Legal risk: assesses if the necessary business laws are in place, the extent to which the country's legal system is compatible with other countries' legal systems, the transparency and clarity of legal procedures, the independence of the legal system from outside actors, and how long-established the legal system is.

Tax risk: assesses the clarity, logic, transparency, and fairness of the taxation system, the taxation burden relative to other countries, and the effectiveness of the country's tax collection system.

Operational risk: assesses the government's stance on foreign investment, the quality of infrastructure in the country, such as rail, road, air, and maritime links, the quality of communications and internet infrastructure, the quality of the public utilities

infrastructure, such as water and energy supply, the quality and availability of labor, the state of labor relations in the country, the probability of strikes. Also describes the quality of bureaucracy and assesses the corruption.

Security risk: assesses the probability of civil unrest, the threat from crime, such as kidnapping, extortion, street violence, burglary, and the threat from terrorism.

Overall risk: aggregates the six specific risk ratings into a single, overall risk rating using the following formula with different weight factors for the individual risk components:

$$Overall\ risk = \sqrt{(0.25 * P^2) + (0.25 * E^2) + (0.15 * L^2) + (0.15 * T^2) + (0.10 * O^2) + (0.10 * S^2)}$$

with

P...Political risk

E...Economic risk

L...Legal risk

T...Tax risk

O...Operational risk

S...Security risk

Overall risk rating:

Overall risk	Overall risk rating
1 ... 1.49	Insignificant
1.5 ... 2.49	Negligible
2.5 ... 2.99	Low
3 ... 3.99	Moderate
4 ... 4.99	Medium
5 ... 5.99	Significant
6 ... 6.99	High
7 ... 7.99	Very high
8 ... 9	Extreme

4. Energy and Electricity Intensity Indicators for the Service Sector

According to the International Energy Agency, the (Commercial and Public) Service sector is here defined as the sum of the following ISIC divisions (Revision 3):

E Electricity, gas, and water supply

41 Collection, purification and distribution of water

G Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods

50 Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel

51 Wholesale trade and commission trade, except of motor vehicles and motorcycles

52 Retail trade and commission trade, except of motor vehicles and motorcycles

H Hotels and restaurants

55 Hotels and restaurants

I Transport, storage and communications

63 Supporting and auxiliary transport activities; activities of travel agencies

64 Post and telecommunications

J Financial intermediation

65 Financial intermediation, except insurance and pension funding

66 Insurance and pension funding, except compulsory social security

67 Activities auxiliary to financial intermediation

K Real estate, renting and business activities

70 Real estate activities

71 Renting of machinery and equipment without operator and of personal and household goods

72 Computer and related activities

73 Research and development

74 Other business activities

L Public administration and defense; compulsory social security

75 Public administration and defense; compulsory social security

M Education

80 Education

N Health and social work

85 Health and social work

O Other community, social and personal service activities

90 Sewage and refuse disposal, sanitation and similar activities

91 Activities of membership organization N.E.C.

92 Recreational, cultural and sporting activities

93 Other service activities

Q Extra-territorial organization and bodies

99 Extra-territorial organization and bodies

The following countries were analyzed for energy and electricity intensities in the service sector (chapters 4.3 and 4.6):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
Angola ¹	Armenia	Australia	Costa Rica	Albania	Iran	Canada	Argentina
Benin	Azerbaijan	New Zealand	El Salvador	Austria	Jordan	Mexico	Bolivia
Cameroon	Bangladesh		Guatemala	Belarus	Lebanon	United States	Brazil
Cote d'Ivoire	Brunei		Haiti	Belgium	Saudi Arabia		Chile
Egypt	China		Honduras	Bulgaria	Turkey		Colombia
Ethiopia	India		Jamaica	Czech Rep.			Ecuador
Gabon	Indonesia		Nicaragua	Denmark			Paraguay
Ghana ¹	Japan		Panama	Estonia			Peru
Kenya	Kazakhstan ¹		Trinidad & Tob	Finland			Uruguay
Morocco	Korea, Rep.			France			Venezuela
Mozambique	Malaysia			Germany			
Namibia ¹	Nepal			Greece			
Nigeria	Pakistan			Hungary			
Senegal	Philippines			Iceland			
South Africa	Singapore			Italy			
Tanzania	Sri Lanka			Latvia			
Togo	Tajikistan			Lithuania			
Tunisia	Thailand			Luxembourg			
Zambia	Uzbekistan			Moldova			
Zimbabwe	Vietnam			Netherlands			
				Norway			
				Poland			
				Portugal			
				Romania			
				Russian Fed.			
				Slovak Rep.			
				Spain			
				Sweden			
				Ukraine			
				UK			

Tab. 4.1: Analyzed countries for energy and electricity intensity in the service sector

¹Note: The service sectors of Angola, Ghana, Kazakhstan, and Namibia, were only analyzed regarding energy intensity and not electricity intensity.

4.1 Energy Consumption in the Service Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Albania	3	3	3	3	3	4	7
Angola	91	103	180	179	226	284	28
Argentina	2396	2365	2390	2484	2678	3144	6
Armenia	82	65	88	28	21	19	-18
Australia	3882	4144	4402	4544	4758	4895	5
Austria	943	1651	1748	1727	2165	2649	25
Azerbaijan	123	109	92	66	44	40	-20
Bahrain	92	98	107	108	119	128	7
Bangladesh	98	89	105	108	113	124	5
Belarus	332	303	310	258	265	261	-4
Belgium	3326	3484	3983	3774	3816	3718	2
Benin			146	157	131	135	-2
Bolivia	36	42	46	52	57	62	12
Brazil	5620	6090	6230	6785	7315	7753	7
Brunei	70	86	106	131	139	135	15
Bulgaria	200	194	244	141	183	649	53
Cameroon	22	21	24	26	29	29	6
Canada	23096	23935	24313	25066	23878	24938	2
Chile	277	301	327	476	499	570	16
China	18337	20060	23257	23865	16903	18497	2
Colombia	869	916	983	1053	1158	1105	5
Costa Rica	124	139	146	158	169	178	8
Cote d'Ivoire	389	422	424	444	464	481	4
Croatia	388	433	428	463	479	477	4
Cuba	210	215	228	245	253	268	5
Cyprus	69	69	70	86	91	105	9
Czech Republic	1245	1989	2027	2080	2394	3028	21
Denmark	1867	1915	1911	1802	1838	1848	0
Ecuador	357	407	405	455	471	431	4
Egypt					717	782	9
El Salvador	77	86	88	97	99	86	3
Eritrea	42	43	47	56	56	65	9
Estonia	269	170	223	251	247	264	2
Ethiopia	11	12	14	16	24	26	20
Finland	967	1005	1420	1450	1484	1503	10
France	20261	20557	22137	21041	22134	22416	2
Gabon	13	13	13	14	14	13	0
Georgia			227	297	326	324	13
Germany	25775	25300	28509	25384	24726	23569	-1
Ghana	18	19	21	23	13	13	-4

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Greece	883	941	1025	1099	1199	1240	7
Guatemala	150	163	166	178	191	199	6
Haiti	48	48	51	48	42	49	1
Honduras	124	137	136	147	164	158	5
Hong Kong, China	1772	1835	1930	2005	2142	2264	5
Hungary	2449	2515	2808	2726	2754	2800	3
Iceland	89	85	76	78	97	112	5
India	1985	2107	2198	2419	2577	2737	7
Indonesia	937	1024	1217	1392	1462	1536	11
Iran	4848	5443	5988	6912	6062	6125	5
Ireland	1254	1182	1241	1305	1334	1434	3
Israel	613	674	737	660	738	922	9
Italy	4146	4280	4427	4619	4822	4635	2
Jamaica	83	120	115	115	137	139	12
Japan	39864	40945	41700	42000	43649	43827	2
Jordan	174	95	211	221	231	249	19
Kazakhstan						54	
Kenya	69	68	68	68	70	71	1
Korea	16913	18625	20294	21486	16958	18718	3
Kuwait	28	30	32	33	37	39	7
Latvia	290	440	546	410	585	620	20
Lebanon	76	55	79	115	110	109	11
Lithuania	671	576	649	584	526	530	-4
Luxembourg	78	80	85	90	93	84	2
Macedonia (Form. Rep.)	40	69	76	84	153	192	40
Malaysia	1420	1582	1789	1587	2016	1941	7
Malta	30	32	34	38	39	40	6
Mexico	3463	3383	3266	3413	3637	3694	1
Moldova	533	594	657	679	631	446	-2
Morocco	150	152	159	167	179	146	0
Mozambique	11	14	22	23	27	27	21
Myanmar	32	36	37	48	54	60	14
Namibia			5	5	5	3	-13
Nepal	88	81	99	108	117	121	7
Netherlands	3350	3171	3627	3763	4116	4437	6
New Zealand	908	896	846	852	878	887	0
Nicaragua	78	65	75	76	77	91	4
Nigeria	217	211	218	221	229	235	2
Norway	1954	1947	2204	2206	2221	2310	4
Oman	134	151	173	181	193	199	8
Pakistan	911	975	1062	1105	1147	1171	5
Panama	148	159	164	184	201	217	8
Paraguay	46	44	54	68	71	75	11
Peru	514	509	583	371	391	400	-3
Philippines	1822	2000	2332	1994	1757	2243	6

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Poland	3800	4017	4518	4424	4597	4896	5
Portugal	766	906	938	1095	1221	1263	11
Qatar	49	83	53	56	65	72	13
Romania	456	506	660	386	719	735	18
Russia	30370	25453	24546	22264	24492	25978	-3
Saudi Arabia	1935	2184	2325	2477	2523	2598	6
Senegal	11	12	12	14	14	14	5
Singapore	422	452	621	697	738	764	13
Slovak Republic	2258	1937	1961	1764	1733	1912	-3
Slovenia	242	257	652	645	707	740	35
South Africa	2357	2486	2561	2804	1836	2055	-1
Spain	4193	4341	4724	5280	5442	5908	7
Sri Lanka	115	182	210	222	231	244	18
Sudan	107	109	157	162	173	178	12
Sweden	4493	4837	5075	4307	4326	4865	2
Switzerland	3187	3244	3546	3331	3548	3405	2
Tajikistan	25	23	23	20	21	25	1
Tanzania	33	36	40	38	39	40	4
Thailand	1730	1980	2217	2512	2573	2270	6
Togo	9	12	12	11	9	10	4
Trinidad and Tobago	66	58	60	72	75	73	3
Tunisia	347	357	378	403	391	431	5
Turkey	1030	1107	1214	1234	1304	1169	3
Ukraine	9345	9267	9427	9329	9601	8963	-1
United Arab Emirates	669	648	866	804	1000	1245	14
United Kingdom	13254	16402	17164	17124	17042	16737	5
United States	167594	172699	178445	182693	180723	182774	2
Uruguay	128	160	167	192	203	187	8
Uzbekistan		2318	1532	2804	3084	3049	14
Venezuela	1808	1897	1934	1928	2042	1966	2
Vietnam	378	773	838	892	853	966	26
Yugoslavia (Fed. Rep.)	24	25	25	27	26	24	0
Zambia	90	90	92	93	92	94	1
Zimbabwe	265	283	280	309	285	259	0

Tab. 4.2: Energy consumption in the service sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the service sector between 1994 and 1999:

Country	Average % change in energy consumption per year (between 1994 to 1999)
Bulgaria	53
Macedonia (Form. Rep.)	40
Slovenia	35
Angola	28
Vietnam	26
Austria	25
Mozambique	21
Czech Republic	21
Latvia	20
Ethiopia	20
Jordan	19
Sri Lanka	18
Romania	18
Chile	16
Brunei	15
Uzbekistan	14
United Arab Emirates	14
Myanmar	14
Georgia	13
Singapore	13
Qatar	13
Jamaica	12
Sudan	12
Bolivia	12
Lebanon	11
Paraguay	11
Portugal	11
Indonesia	11
Finland	10
Eritrea	9
Israel	9
Cyprus	9
Egypt	9
Uruguay	8
Oman	8
Panama	8
Costa Rica	8
Malaysia	7
Spain	7

Country	Average % change in energy consumption per year (between 1994 to 1999)
Greece	7
Nepal	7
Kuwait	7
Bahrain	7
Brazil	7
Albania	7
India	7
Saudi Arabia	6
Thailand	6
Netherlands	6
Malta	6
Cameroon	6
Guatemala	6
Argentina	6
Philippines	6
Iceland	5
Poland	5
Iran	5
Bangladesh	5
United Kingdom	5
Pakistan	5
Senegal	5
Honduras	5
Colombia	5
Hong Kong, China	5
Cuba	5
Australia	5
Tunisia	5
Cote d'Ivoire	4
Croatia	4
Ecuador	4
Tanzania	4
Nicaragua	4
Togo	4
Norway	4
Korea	3
Ireland	3
Hungary	3
Turkey	3
El Salvador	3
Trinidad and Tobago	3
Belgium	2
Estonia	2
Italy	2
France	2

Country	Average % change in energy consumption per year (between 1994 to 1999)
Sweden	2
Japan	2
United States	2
Venezuela	2
Luxembourg	2
China	2
Nigeria	2
Canada	2
Switzerland	2
Mexico	1
Haiti	1
Zambia	1
Tajikistan	1
Kenya	1
Yugoslavia (Fed. Rep.)	0
Gabon	0
Morocco	0
Denmark	0
Zimbabwe	0
New Zealand	0
Ukraine	-1
South Africa	-1
Germany	-1
Benin	-2
Moldova	-2
Russia	-3
Slovak Republic	-3
Peru	-3
Ghana	-4
Lithuania	-4
Belarus	-4
Namibia	-13
Armenia	-18
Azerbaijan	-20
Kazakhstan	...

Tab. 4.3: Average annual change in energy consumption in the service sector between 1994 and 1999.

4.2 Energy Consumption in the Service Sector by Fuel

	Coal [%]	Natural gas [%]	LPG [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Albania	0	0	0	0	100	0	0
Angola	0	0	4	96	0	0	0
Argentina	0	50	1	4	45	0	0
Armenia	0	0	0	0	100	0	0
Australia	0	22	5	1	71	0	1
Austria	0	28	2	23	23	20	5
Azerbaijan	0	25	0	30	38	8	0
Bahrain	0	0	0	0	100	0	0
Bangladesh	0	65	0	0	35	0	0
Belarus	0	0	0	3	96	0	1
Belgium	0	40	2	30	27	0	1
Benin	0	0	0	0	8	0	92
Bolivia	0	3	0	0	97	0	0
Brazil	0	1	6	12	79	0	2
Brunei	0	0	0	0	100	0	0
Bulgaria	0	2	0	19	59	18	2
Cameroon	0	0	0	0	100	0	0
Canada	0	38	3	16	42	0	0
Chile	0	7	22	6	62	0	3
China	26	1	4	24	29	2	13
Chinese Taipei	0	6	0	20	72	0	2
Colombia	0	7	6	28	58	0	0
Costa Rica	0	0	6	14	76	0	3
Cote d'Ivoire	0	0	0	6	23	0	71
Croatia	1	21	1	26	47	4	0
Cuba	0	0	4	0	88	0	8
Cyprus	0	0	0	0	100	0	0
Czech Republic	5	41	0	1	29	22	1
Denmark	0	8	0	9	45	35	3
Ecuador	0	0	4	48	37	0	10
Egypt	0	0	0	0	100	0	0
El Salvador	0	0	0	0	100	0	0
Eritrea	0	0	0	74	5	0	22
Estonia	2	3	0	13	41	38	3
Ethiopia	0	0	0	0	100	0	0
Finland	0	2	0	24	74	0	0
France	0	38	1	22	37	0	1
Gabon	0	0	0	0	100	0	0
Georgia	0	0	0	3	69	0	28
Germany	1	25	1	34	39	0	1
Ghana	0	0	0	100	0	0	0
Greece	0	1	3	17	80	0	0
Guatemala	0	0	14	32	53	0	1
Haiti	0	0	0	0	8	0	92

	Coal [%]	Natural gas [%]	LPG [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Honduras	0	0	0	26	45	0	29
Hong Kong, China	0	0	9	0	81	0	10
Hungary	0	61	2	0	25	9	2
Iceland	0	0	0	0	53	15	32
India	0	0	0	0	100	0	0
Indonesia	0	0	0	22	52	0	26
Iran	0	28	2	46	23	0	1
Ireland	0	17	1	52	30	0	0
Israel	0	0	0	0	100	0	0
Italy	0	0	0	0	100	0	0
Jamaica	0	0	8	9	74	0	9
Japan	0	10	6	23	49	1	12
Jordan	0	0	7	50	37	0	6
Kazakhstan	0	0	0	100	0	0	0
Kenya	0	0	0	0	31	0	69
Korea	0	8	14	14	26	0	37
Kuwait	0	0	0	0	100	0	0
Latvia	7	7	0	6	22	23	35
Lebanon	0	0	0	0	100	0	0
Lithuania	12	8	0	3	31	37	9
Luxembourg	0	0	0	0	100	0	0
Macedonia	8	0	0	36	39	8	9
Malaysia	0	0	24	6	70	0	0
Malta	0	0	0	0	100	0	0
Mexico	0	0	38	23	38	0	1
Morocco	0	0	0	0	100	0	0
Mozambique	0	0	0	33	67	0	0
Myanmar	0	0	0	0	100	0	0
Namibia	0	0	0	100	0	0	0
Nepal	21	0	16	0	7	0	56
Netherlands	0	0	1	25	55	18	1
New Zealand	9	14	1	9	67	0	0
Nicaragua	0	0	23	20	42	0	15
Nigeria	0	0	0	0	100	0	0
Norway	0	0	0	14	82	4	0
Oman	0	0	0	0	100	0	0
Pakistan	0	41	0	12	46	0	1
Panama	0	0	13	6	80	0	1
Paraguay	0	0	0	0	95	0	5
Peru	0	0	0	27	17	0	56
Philippines	0	0	20	33	41	0	5
Poland	7	20	1	3	39	13	16
Portugal	0	1	5	20	71	0	4
Qatar	0	0	0	0	100	0	0
Republic of Moldova	5	74	0	6	15	0	0
Romania	0	51	0	5	40	0	3
Russia	3	9	4	0	20	62	1
Saudi Arabia	0	0	0	0	100	0	0

	Coal [%]	Natural gas [%]	LPG [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Senegal	0	0	0	0	100	0	0
Singapore	0	0	0	0	100	0	0
Slovak Republic	24	37	0	0	27	9	3
Slovenia	1	10	5	44	31	1	6
South Africa	24	0	0	0	74	0	1
Spain	0	9	4	21	65	0	1
Sri Lanka	0	0	9	0	39	0	52
Sudan	0	0	0	0	15	0	85
Sweden	0	0	1	28	46	25	0
Switzerland	0	14	0	42	38	2	3
Tajikistan	0	0	0	0	100	0	0
Tanzania	0	0	0	0	100	0	0
Thailand	0	0	0	0	100	0	0
Togo	0	0	0	0	100	0	0
Trinidad and Tobago	0	0	40	4	56	0	0
Tunisia	0	9	2	51	36	0	2
Turkey	0	0	0	0	100	0	0
Ukraine	0	92	0	0	8	0	0
United Arab Emirates	0	0	0	0	100	0	0
United Kingdom	1	43	0	10	46	0	1
United States	1	39	1	6	51	1	2
Uruguay	0	0	0	19	77	0	4
Uzbekistan	0	91	0	0	9	0	0
Venezuela	0	22	0	2	76	0	0
Vietnam	9	0	13	37	11	0	31
Yugoslavia (Fed. Rep.)	0	0	0	0	100	0	0
Zambia	0	0	0	63	37	0	0
Zimbabwe	46	0	0	0	54	0	0

Tab. 4.4: Share of various fuels in the total final energy consumption in the service sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

4.3 Energy Intensity in the Service Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the service sector (in toe) and value added in the service sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

World Bank, World Development Indicators (2002)

Methodology used to calculate the energy intensity:

The energy consumption in the service sectors listed above (ISIC divisions 41, 50, 51, 52, 55, 63, 64, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93 and 99, ISIC revision 3) was taken from the IEA Energy Balances database.

The value added in the service sectors (ISIC divisions 50 - 99, ISIC revision 3) was taken from the World Bank World Development Indicators database. According to the World Bank, value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The World Bank data includes value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties.

The coverage of the service sectors is not the same in both databases. The IEA definition covers the ISIC sector 41 (collection, purification and distribution of water), which is not included in the definition of the World Bank. On the other hand, the World Bank database covers the ISIC sectors 60 (land transport, transport via pipelines), 61 (water transport), 62 (air transport), and 95 (private households with an employed person), which are not included under the definition of the IEA. The biggest discrepancy is that the transport sector (ISIC divisions 60, 61, and 62) is included in the value added, but not included in the energy consumption.

However, for most countries, the share of value added in the transport sector in total GDP is about 3 to 5% according to the World Bank. Since the share of the value added in the service sector in total GDP is for most countries about 60 to 70%, the effect of the inconsistency in the service sector definitions in the nominator (energy consumption) and

the denominator (value added) should be relatively minor. The importance of the ISIC sectors 41 (collection, purification and distribution of water) and 95 (private households with an employed person) relatively to the whole service sector should not be too big, neither.

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The use of *constant 1995 US dollars* - versus *current* US dollars - to express the value added in the service sector of various countries allows analyzing trends in energy intensity over time within one country, leaving out the effect of price inflation.

The use of *purchasing power parities (PPPs)* - versus official exchange rates - to convert constant national currency into constant US dollars allows to compare the value added and, thus, the energy intensity, in different countries at the same time, leaving out the difference in price levels among the analyzed countries.

From the explanation of purchasing power parities in chapter 2 follows that for comparing output levels or productivity levels between countries, PPP based comparisons are in general more useful than exchange rates based comparisons. An exception would be the case where one compares the productivity of a certain industrial or service sector in, for example, China with the US, and the Chinese sector derives its revenues mainly from exports to the US or Europe. In that case it would be inappropriate to convert the value added of the Chinese industry or service sector into US dollars using PPPs, which represent the purchasing power in China and not in the US or Europe.

The source of PPP data used in this work to convert the value added from the service sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the service sector only. However, the difference is generally small.

Energy intensity (energy use per value added) in the service sector
(countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Uzbekistan	260	11	14	3
Ukraine	149	5	-1	-6
Moldova	107	-7	-2	6
Angola	96	20	28	7
Latvia	85	16	20	4
Brunei ¹	69	8	15	6
Canada	58	-1	2	3
Slovak Republic	55	-7	-3	5
Korea, Rep.	52	-2	3	5
Hungary	52	0	3	3
Russian Federation	51	-2	-3	-1
Czech Republic	50	19	21	1
Benin	49	-7	-2	5
Lithuania	45	-8	-4	4
Sweden	43	-1	2	3
Estonia	42	-2	2	5
Iran, Islamic Rep.	37	-4	5	10
Norway	36	0	4	3
Cote d'Ivoire	36	-1	4	6
Bulgaria	36	50	53	-3
United States ³	33			
Venezuela, RB	31	1	2	1
Saudi Arabia ²	31	5	6	1
Poland	31	0	5	5
Iceland ²	30	1	5	4
France	27	0	2	2
Zambia	27	-4	1	5
Belgium	25	0	2	2
Honduras	25	1	5	4
Ecuador	24	5	4	-1
Finland	24	6	10	4
Austria	24	23	25	2
Malaysia	24	3	7	5
Jordan	23	14	19	5
United Kingdom	22	2	5	4
Denmark	22	-3	0	3
Jamaica	22	12	12	0

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Japan	22	0	2	2
New Zealand	21	-4	0	4
Germany	21	-4	-1	3
Netherlands	19	2	6	4
Nicaragua ¹	19	1	4	3
Panama	19	4	8	3
Vietnam	17	17	26	7
Belarus	17	-7	-4	4
Zimbabwe	17	-4	0	4
Philippines	16	1	6	5
Australia	16	0	5	5
Romania	15	18	18	-1
Portugal	15	8	11	3
Brazil	15	4	7	3
Spain	15	4	7	3
Greece	14	4	7	3
Singapore	14	7	13	6
China	14	-6	2	8
Trinidad and Tobago	14	-1	3	4
Thailand	13	5	6	1
Tunisia	13	-1	5	5
Costa Rica	13	3	8	4
Nepal	12	1	7	5
Argentina	12	3	6	3
Nigeria	11	-1	2	3
Pakistan	11	1	5	4
Lebanon	10	6	11	4
Chile	10	13	16	3
South Africa	10	-4	-1	3
Uruguay	10	6	8	3
Colombia	9	2	5	3
Guatemala	9	1	6	5
Armenia	9	-23	-18	7
Sri Lanka	9	11	18	6
Haiti	9	-1	1	2
Mexico	8	-1	1	2
Egypt, Arab Rep.	8		9	6
Mozambique	8	25	21	-3
Luxembourg	7	-4	2	6
Indonesia	7	11	11	0
Paraguay	7	10	11	0

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Italy	6	0	2	2
Tanzania	6	0	4	4
Turkey	6	-1	3	4
El Salvador	6	-1	3	4
Peru	6	-6	-3	4
Bolivia	5	7	12	5
Kenya	5	-3	1	3
Cameroon	5	6	6	0
Gabon	5	-3	0	4
Azerbaijan	5	-30	-20	16
Tajikistan	4	-5	1	11
Togo	4	1	4	2
Morocco	3	-3	0	3
India	3	-2	7	9
Albania	2	6	7	2
Ethiopia	2	10	20	8
Senegal	2	-1	5	6
Kazakhstan	1		19	0
Bangladesh	1	1	5	5
Ghana	1	-7	-4	4
Namibia	1	-16	-13	4

Tab. 4.5: Energy intensity (energy consumption per value added) in the service sector

Notes:

¹ For Brunei and Nicaragua the value added in 1999 was estimated by extrapolating the data for value added between 1994 and 1998.

² For Iceland and Saudi Arabia the value added in 1999 was estimated by extrapolating the data for value added between 1994 and 1997.

³ For the United States the energy intensity in 1999 was estimated by extrapolating data for energy intensity in the service sector for the years 1980 to 1997 from APERC (2001).

Shortcomings of Tab. 4.5:

Energy use

Energy consumption comprises the use of fossil fuels, biomass, heat, and electricity. Each fuel is often used for specific end uses. Because fossil fuels, biomass, and heat tend to be

less expensive than electricity, these fuels are preferably used for space and water heating. On the other hand, electricity is almost exclusively used for air conditioning, lighting, office equipment, elevators, escalators and ventilation equipment. For this reason, we provide the reader with a separate analysis of pure electricity use in the service sector at the end of this chapter, which gives a better picture about energy efficiency for those end uses that tend to consume electricity only.

Value Added

Value added in the service sector is an indicator for the activity in this sector. However, it is only weakly correlated to energy consumption. There are some service sectors that require a great deal of energy per unit of value added (e.g. retail trade), and other sectors that consume very little energy (parking, warehousing). There are also big differences among service sectors regarding the value added. While for a public museum and a gold trading firm the energy requirement may be similar – assuming both are located in the same building –, the value added, and thus the energy intensity, is likely to be different.

For this reason, other and more energy-related measures of activity than value added may be more useful. Such an indicator could be the number of employees, floor space, or floor space times opening hours. However, also each of those activity measures has its limitations. The number of employees is only strongly correlated with energy consumption for office equipment and hot water usage, which accounts for only 10-20 percent of overall energy demand in services (Krackeler et al., 1999). Floor space is more strongly correlated with energy consumption for space conditioning and lighting (Krackeler et al, 1999). However, floor space data is available for only a limited number of countries. Besides, particularly in warmer, developing countries, a substantial amount of business activity occurs outdoors, often in front of homes that also serve as stores. International comparison of floor space data is therefore problematic.

The next section provides an analysis of energy intensity using employment as a measure for activity. Both indicators of energy intensity (energy use per value added and energy use per employee) should be considered to derive a better picture about energy intensity and energy efficiency in the service sector.

Climate Influence

In many countries a high share of energy consumption in the service sector can be attributed to office space heating or cooling. Thus, this part of energy consumption and energy intensity of the service sector depends on the climate. In order to accurately compare energy intensities for countries of different climate one would need to correct the energy use according the space heating and cooling shares of total final energy demand and the number of heating and cooling degree days. For this, however, one would need data about space heating or cooling consumption and degree days, which is not available for all countries in a common methodology, especially not for developing countries.

One can find, however, climate corrected energy intensities in the service sector in regional studies, such as the ODYSSEE study for the European Union, or the APERC study for the Asia-Pacific region.

Trends in Energy Intensity

Table 4.5 lists in the third column the change of energy intensity by the time. The change of energy intensity can be the result of various factors: change in the equipment used in the service sector, managerial change in the service sector, behavioral change, economic change that leads to a higher or lower value added, structural changes within the service sector, yearly climatic fluctuations, etc. The overall change in the energy intensity, as stated in the third column in Tab. 4.5, does, therefore, not necessarily indicate any change – positive or negative – in technological energy efficiency. The effect of structural changes can be very important, particularly in countries with a rapid economic growth, such as, for instance, most of East Asian countries.

To better monitor technological energy efficiency trends by the time, it would be necessary to leave out the influence of structural changes. This could be done by calculating the energy intensity at constant structure of the value added between major service branches. For this, one would need, however, data about the energy consumption and the value added in the various service branches, which was not easily obtainable for all countries.

4.4 Energy Intensity in the Service Sector (Energy Use per Employee)

Energy intensity is here defined as the ratio between total final energy consumption in the service sector (in koe) and the number of employees in the service sector.

Data sources:

For energy consumption:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For the number of employees in the service sector:

World Bank, World Development Indicators (2002)

Methodology used to calculate the energy intensity:

The energy consumption in the service sectors listed above (ISIC divisions 41, 50, 51, 52, 55, 63, 64, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93 and 99, ISIC revision 3) was taken from the IEA Energy Balances database.

The number of employees in the service sectors (ISIC divisions 50 - 99, ISIC revision 3) was taken from the World Bank World Development Indicators database.

The coverage of the service sectors is not the same in both databases. The IEA definition covers the ISIC sector 41 (collection, purification and distribution of water), which is not included in the definition of the World Bank. On the other hand, the World Bank database covers the ISIC sectors 60 (land transport, transport via pipelines), 61 (water transport), 62 (air transport), and 95 (private households with an employed person), which are not included under the definition of the IEA.

Energy intensity (energy use per employee) in the service sector
(countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Final energy consumption [koe] per employee)	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in labor force per year between 1994 and 1999
Ukraine	2130	-2	-1	1
Canada	2055	0	2	1
United States	1718	0	2	2
Ireland	1462	-1	3	3
Slovenia	1439	31	35	3
Sweden	1406	2	2	0
Norway	1366	2	4	1
Korea (Rep.)	1289	-2	3	5
Switzerland	1278	0	2	1
Belgium [†]	1232	1	2	1
Slovak Republic	1203	-5	-3	3
France	1149	1	2	1
Austria	1104	24	25	1
Iceland [†]	1089	4	5	1
Japan	1031	1	2	1
Hungary	1005	3	3	0
Czech Republic	961	19	21	2
Germany	921	-3	-1	1
Denmark [†]	893	-1	0	1
Finland	879	10	10	0
Netherlands [†]	824	5	6	1
Hong Kong, China	815	0	5	5
Latvia	804	19	20	1
United Kingdom	778	4	5	1
New Zealand	692	-3	0	2
Australia	688	3	5	2
Luxembourg [†]	618	-1	2	2
Estonia	578	1	2	1
Russia	569	-6	-3	5
Moldova	555	-5	-2	3
Spain	552	6	7	1
Singapore	545	9	13	4
Lithuania	523	-6	-4	2
Poland [†]	495	2	5	3
Israel	487	4	9	5
Portugal	478	12	11	-1
Greece [†]	457	5	7	2
Croatia	437	5	4	0
Malaysia	417	-1	7	9

Country	Energy intensity in 1999 (Final energy consumption [koe] per employee)	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in labor force per year between 1994 and 1999
Bulgaria	351	51	53	1
Italy	293	1	2	1
Panama	288	4	8	4
Argentina ¹	285	2	6	3
Romania	224	15	18	2
Costa Rica	213	3	8	4
Trinidad and Tobago ¹	198	0	3	3
Thailand	188	0	6	6
China ¹	183	-3	2	4
Mexico	176	-1	1	2
Uruguay	174	6	8	2
Brazil ¹	173	3	7	3
Jamaica ¹	169	9	12	3
Philippines	159	0	6	5
Honduras	158	1	5	4
Chile ¹	156	13	16	3
Ecuador	126	1	4	4
Nicaragua	120	1	4	3
Turkey	113	1	3	3
Sri Lanka ¹	84	16	18	3
Colombia	82	0	5	5
Egypt ¹	68	4	9	5
Pakistan	66	0	5	5
El Salvador ¹	63	-3	3	6
Peru	56	-6	-3	4
Indonesia ¹	39	6	11	4
Tajikistan ¹	35	-6	1	9
Azerbaijan	25	-25	-20	7
Morocco	22	-4	0	4
Kazakhstan	12			4
Myanmar ¹	9	7	14	6
Kenya	8	-3	1	3

Tab. 4.6: Energy intensity (energy consumption per employee) in the service sector

Notes:

¹ The number of employees in 1999 was estimated by extrapolating the available data for the number of employees from 1994 to 1998.

Shortcomings of Tab. 4.6

Energy use

Energy consumption comprises the use of fossil fuels, biomass, heat, and electricity. Each fuel is often used for specific end uses. Because fossil fuels, biomass, and heat tend to be less expensive than electricity, these fuels are preferably used for space and water heating. On the other hand, electricity is almost exclusively used for air conditioning, lighting, office equipment, elevators, escalators and ventilation equipment. For this reason, we provide the reader with a separate analysis of pure electricity use in the service sector at the end of this chapter, which gives a better picture about energy efficiency for those end uses that tend to consume electricity only.

Employment

Employment in the service sector is an indicator for the activity in this sector. However, it is only weakly correlated to energy consumption. The number of employees is only strongly correlated with energy consumption for office equipment and hot water usage, which accounts for only 10-20 percent of overall energy demand in services (Krackeler et al., 1999).

Climate Influence

In many countries a high share of energy consumption in the service sector can be attributed to office space heating or cooling. Thus, this part of energy consumption and energy intensity of the service sector depends on the climate. In order to accurately compare energy intensities for countries of different climate one would need to correct the energy use according the space heating and cooling shares of total final energy demand and the number of heating and cooling degree days. For this, however, one would need data about space heating or cooling consumption and degree days, which is not available for all countries in a common methodology, especially not for developing countries.

One can find, however, climate corrected energy intensities in the service sector in regional studies, such as the ODYSSEE study for the European Union, or the APERC study for the Asia-Pacific region.

Trends in Energy Intensity

Table 4.6 lists in the third column the change of energy intensity by the time. The change of energy intensity can be the result of various factors: change in the equipment used in the service sector, managerial change in the service sector, behavioral change, economic change that leads to a higher or lower employment, structural changes within the service sector, yearly climatic fluctuations, etc. The overall change in the energy intensity, as stated in the third column in Tab. 4.6, does, therefore, not necessarily indicate any change – positive or negative – in technological energy efficiency. The effect of structural changes can be very important, particularly in countries with a rapid economic growth, such as, for instance, most of East Asian countries.

Comparison of Energy Consumption per Employee and Energy Consumption per Value Added

Comparing Tab. 4.5 and Tab. 4.6 shows in general a good match of the relative ranking of the countries regarding the energy intensity in the service sector. However, there is a systematic difference in the ranking for two groups of countries: Countries in transition (formerly centrally planned economies in Eastern Europe and Russia) and advanced economies in Western Europe and Japan.

Countries in transition (Commonwealth of Independent States, Central and Eastern European countries) show a very high energy intensity, if intensity is defined as energy consumption per value added, and only a moderate to high energy intensity, if intensity is defined as energy use per employee. This is explainable due to the economic breakdown of the economies in transition after the collapse of the Soviet Union in 1989 and the resulting declining value added, which was not always accompanied by a proportional decline in employment. Therefore, the number of employees in the service sector relative to the value added may be high by international comparison (low labor productivity).

On the other hand, some highly advanced economies, such as Japan and Western European countries, show lower energy intensity, if intensity is defined as energy consumption per value added, than if it is defined as energy consumption per employee. This results from the fact that labor productivity in the service sector (value added per employee) is very high in these countries.

Apart from these differences, there are several countries that show very high energy intensity using either of the two definitions. These are the Ukraine, Canada, the Republic of Korea, the Slovak Republic, Sweden, Hungary, and Norway. In some of these countries, such as Canada, Sweden, and Norway, the high energy intensity can at least partially be attributed to the cold climate. In the ODYSSEE study one can find values for the energy intensity in the service sector that are corrected to the average European climate. The study provides climate-corrected energy intensity values for Sweden and Norway using three different definitions: energy use per value added, energy use per employee, and energy use per square meter of office space. However, even with climate correction, Sweden and Norway show one of the highest values for energy intensity among EU countries in the service sector, using any of the three definitions.

4.5 Electricity Consumption in the Service Sector

In general, electricity tends to be more expensive than fossil fuels, biomass, or heat. Therefore, electricity is almost exclusively used in the service sector for air conditioning, lighting, office equipment, elevators, escalators and ventilation equipment, whereas fossil and biomass fuels are preferably used for space and water heating. In this and the following chapters, we provide the reader with a separate analysis of pure electricity consumption and electricity intensity in the service sector. This will allow for a better energy efficiency analysis of those types of end uses in the service sector that tend to be powered predominately by electricity.

Country	Total final electricity consumption [GWh]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Albania	35	35	35	35	35	47	7
Argentina	11049	11828	12863	13770	15607	16549	8
Armenia	954	756	1023	326	244	221	-18
Australia	30796	33041	35378	36995	38926	40391	6
Austria	4757	4954	5001	5780	5117	6955	9
Azerbaijan	1163	1023	861	582	209	174	-28
Bahrain	1070	1140	1244	1256	1384	1489	7
Bangladesh	407	407	419	419	430	500	4
Belarus	3861	3524	3605	2977	3035	2908	-5
Belgium	10095	10269	10874	10990	11572	11735	3
Benin	12	12	81	105	116	128	130
Bolivia	419	477	523	582	640	698	11
Brazil	50358	55382	58859	64023	68838	71304	7
Brunei	814	1000	1233	1524	1617	1570	15
Bulgaria	1419	1454	1640	1361	1477	4419	41
Cameroon	256	244	279	302	337	337	6
Canada	113765	117033	118603	121301	119836	122208	1
Chile	2675	2931	3210	3524	3873	4105	9
China	35948	40217	43461	53684	56301	61511	12
Chinese Taipei	14863	16003	16980	18259	21039	21864	8
Colombia	6210	6373	6606	6792	7792	7513	4
Costa Rica	1186	1337	1361	1465	1547	1582	6
Cote d'Ivoire	791	1023	989	1082	1210	1291	11
Croatia	2012	2233	2419	2547	2477	2628	6
Cuba	2035	2105	2186	2419	2547	2745	6
Cyprus	802	802	814	1000	1058	1221	9
Czech Republic	8350	9188	9897	10153	10339	10258	4
Denmark	8781	8885	9223	9385	9665	9676	2

Country	Total final electricity consumption [GWh]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Ecuador	1349	1430	1582	1745	1942	1849	7
Egypt					8339	9095	9
El Salvador	896	1000	1023	1128	1151	1000	3
Eritrea	23	35	23	23	35	35	13
Estonia	1233	1186	1244	1396	1489	1244	1
Ethiopia	128	140	163	186	279	302	20
Finland	11246	11397	11839	12153	12560	12886	3
Former USSR	86504	86620	88179	84469	87062	85120	0
France	92703	92796	94494	92412	94343	97413	1
Gabon	151	151	151	163	163	151	0
Georgia			2442	2535	2756	2582	2
Germany	94017	95110	98774	100088	103472	106542	3
Greece	7897	8374	8827	9792	10839	11479	8
Guatemala	954	1012	1058	1116	1198	1233	5
Haiti		12	23	105	23	47	118
Honduras	477	628	698	779	861	826	12
Hong Kong, China	16061	16724	17992	18945	20608	21213	6
Hungary	6559	7106	7327	7734	8001	8036	4
Iceland	582	547	454	477	651	686	5
India	23086	24504	25563	28133	29971	31831	7
Indonesia	4210	5094	6222	7257	8664	9327	17
Iran	13747	13863	14223	14886	15561	16189	3
Ireland	3442	3594	3908	4187	4466	4966	8
Israel	7129	7839	8571	7676	8583	10723	9
Italy	48125	49695	51405	53719	56080	53905	2
Jamaica	686	1163	1151	1163	1175	1198	14
Japan	206956	212841	220493	229413	240915	247277	4
Jordan	721	791	861	919	1012	1082	8
Kenya	267	267	256	244	256	256	-1
Korea (Rep.)	32343	37088	43601	50323	50323	57243	12
Kuwait	326	349	372	384	430	454	7
Latvia	1524	1465	1628	1582	1628	1558	1
Lebanon	884	640	919	1337	1279	1268	11
Lithuania	1105	907	1791	1710	1872	1907	17
Luxembourg	907	930	989	1047	1082	977	2
Macedonia (Form. Yug. Rep.)	361	512	593	698	721	872	20
Malaysia	15863	18003	20306	13840	18457	15747	3
Malta	349	372	395	442	454	465	6
Mexico	15154	14933	14444	14979	15712	16433	2
Moldova	1012	1093	1082	1035	965	791	-4
Morocco	1745	1768	1849	1942	2082	1698	0
Mozambique	128	163	151	186	209	209	11
Myanmar	372	419	430	558	628	698	14

Country	Total final electricity consumption [GWh]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Nepal	105	128	140	140	151	105	2
Netherlands	23527	21923	24132	25609	27645	28389	4
New Zealand	5664	5582	5931	6455	6873	6920	4
Nicaragua	267	291	314	372	395	442	11
Nigeria	2524	2454	2535	2570	2663	2733	2
Norway	18422	18445	20225	21108	21376	22039	4
Oman	1558	1756	2012	2105	2245	2314	8
Pakistan	4861	5245	5896	6071	6571	6210	5
Panama	1303	1419	1442	1733	1896	2012	9
Paraguay	488	465	593	756	779	826	12
Peru	1884	2559	2721	721	768	802	-4
Philippines	8513	8839	10769	11816	8699	10793	7
Poland	17073	17398	17666	16084	21050	22423	6
Portugal	6152	6920	7373	8676	9490	10444	11
Qatar	570	965	616	651	756	837	13
Romania	1965	1965	3431	1337	2687	3419	28
Russia	61046	60057	61418	59790	62418	61569	0
Saudi Arabia	22504	25400	27040	28808	29342	30215	6
Senegal	128	140	140	163	163	163	5
Singapore	4908	5257	7222	8106	8583	8885	13
Slovak Republic	3640	5303	5687	5140	4105	5955	14
Slovenia	1593	1721	1919	2117	2210	2698	11
South Africa	14061	17317	19783	22190	14003	17736	8
Spain	29994	29575	33948	39658	41112	44973	9
Sri Lanka	1198	791	779	907	1012	1116	1
Sudan	128	151	198	209	279	302	19
Sweden	25702	26074	25993	22109	22341	25958	1
Switzerland	13468	13770	14084	14165	14421	15131	2
Tajikistan	291	267	267	233	244	291	1
Tanzania	384	419	465	442	454	465	4
Thailand	20120	23027	25784	29215	29924	26400	6
Togo	105	140	140	128	105	116	4
Trinidad and Tobago	349	361	361	419	430	477	7
Tunisia	989	1012	1082	1186	1361	1826	14
Turkey	11979	12874	14119	14351	15166	13595	3
Ukraine	12084	12805	9665	9281	9199	8769	-6
United Arab Emirates	7780	7536	10072	9351	11630	14479	14
United Kingdom	77002	80642	83783	88504	88260	89156	3
United States	914304	954416	981200	1027371	1068064	1083055	3
Uruguay	954	1337	1454	1628	1698	1675	13
Uzbekistan	2245	3536	3163	3024	3012	3117	9
Venezuela	14398	15270	15735	16084	17259	17398	4
Vietnam	756	896	977	1105	1221	1198	10
Yugoslavia (Fed. Rep.)	279	291	291	314	302	279	0

Country	Total final electricity consumption [GWh]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Zambia	395	395	395	407	395	407	1
Zimbabwe	1349	1361	1524	1826	1884	1640	5

Tab. 4.7: Electricity consumption in the service sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in electricity consumption is a good indicator for promising markets for the export of certain energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in electricity consumption in the service sector between 1994 and 1999:

Country	Average % change per year in electricity consumption between 1994 and 1999
Benin	130
Haiti	118
Bulgaria	41
Romania	28
Macedonia (Form. Yug. Rep.)	20
Ethiopia	20
Sudan	19
Indonesia	17
Lithuania	17
Brunei	15
Jamaica	14
United Arab Emirates	14
Myanmar	14
Slovak Republic	14
Tunisia	14
Eritrea	13
Singapore	13
Qatar	13
Uruguay	13

Country	Average % change per year in electricity consumption between 1994 and 1999
Korea (Rep.)	12
Honduras	12
Paraguay	12
China	12
Slovenia	11
Lebanon	11
Portugal	11
Mozambique	11
Cote d'Ivoire	11
Bolivia	11
Nicaragua	11
Vietnam	10
Panama	9
Uzbekistan	9
Israel	9
Cyprus	9
Egypt	9
Austria	9
Chile	9
Spain	9
Jordan	8
Argentina	8
Oman	8
Chinese Taipei	8
South Africa	8
Greece	8
Ireland	8
Brazil	7
Kuwait	7
Bahrain	7
Ecuador	7
Albania	7
India	7
Philippines	7
Trinidad and Tobago	7
Poland	6
Cuba	6
Saudi Arabia	6
Thailand	6
Costa Rica	6
Malta	6
Cameroon	6
Hong Kong, China	6
Croatia	6

Country	Average % change per year in electricity consumption between 1994 and 1999
Australia	6
Guatemala	5
Pakistan	5
Senegal	5
Iceland	5
Zimbabwe	5
Bangladesh	4
Czech Republic	4
Hungary	4
New Zealand	4
Tanzania	4
Colombia	4
Netherlands	4
Venezuela	4
Norway	4
Japan	4
Togo	4
United States	3
Iran	3
Belgium	3
United Kingdom	3
Turkey	3
Finland	3
El Salvador	3
Malaysia	3
Germany	3
Switzerland	2
Italy	2
Georgia	2
Denmark	2
Nepal	2
Mexico	2
Luxembourg	2
Nigeria	2
Canada	1
France	1
Estonia	1
Sweden	1
Latvia	1
Zambia	1
Tajikistan	1
Sri Lanka	1
Russia	0
Yugoslavia (Fed. Rep.)	0

Country	Average % change per year in electricity consumption between 1994 and 1999
Gabon	0
Morocco	0
Former USSR	0
Kenya	-1
Peru	-4
Moldova	-4
Belarus	-5
Ukraine	-6
Armenia	-18
Azerbaijan	-28

Tab. 4.8: Average annual change in electricity consumption between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

4.6 Electricity Intensity in the Service Sector (Electricity Use per Value Added)

Electricity intensity is here defined as the ratio between total electricity consumption in the service sector (in GWh) and value added in the service sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For electricity consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

World Bank, World Development Indicators (2002)

Methodology used to calculate the electricity intensity:

The electricity consumption in the service sectors listed above (ISIC divisions 41, 50, 51, 52, 55, 63, 64, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93 and 99, ISIC revision 3) was taken from the IEA Energy Balances database.

The value added in the service sectors (ISIC divisions 50 - 99, ISIC revision 3) was taken from the World Bank World Development Indicators database.

The coverage of the service sectors is not the same in both databases. The IEA definition covers the ISIC sector 41 (collection, purification and distribution of water), which is not included in the definition of the World Bank. On the other hand, the World Bank database covers the ISIC sectors 60 (land transport, transport via pipelines), 61 (water transport), 62 (air transport), and 95 (private households with an employed person), which are not included under the definition of the IEA. For further explanation see chapter 4.3 under "Methodology to calculate the energy intensity."

Electricity intensity (electricity consumption per value added) in the service sector (countries ranked from highest to lowest electricity intensity):

Country	Electricity intensity in 1999 (kWh per value added [thousands 1995 US \$ PPP])	Average % change in electricity intensity per year between 1994 and 1999	Average % change in electricity consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Brunei	803	8	15	6
Saudi Arabia	361	5	6	1
Norway	348	0	4	3
Canada	286	-2	1	3
Venezuela	276	3	4	1
Uzbekistan	266	6	9	3
Bulgaria	243	41	41	-3
Sweden	227	-2	1	3
Latvia	214	-3	1	4
Finland	209	-1	3	4
Malaysia	197	-1	3	5
Estonia	196	-4	1	5
United States [†]	196			
Moldova	190	-9	-4	6
Jamaica	189	15	14	0
Belarus	187	-8	-5	4
Iceland	186	0	5	4
Panama	172	6	9	3
Slovak Republic	172	9	14	5
Czech Republic	169	3	4	1
Singapore	163	7	13	6
New Zealand	163	1	4	4
Lithuania	162	13	17	4
Korea (Rep.)	159	7	12	5
Thailand	156	5	6	1
Hungary	148	2	4	3
Ukraine	145	0	-6	-6
Poland	142	1	6	5
Brazil	136	4	7	3
Australia	134	1	6	5
Greece	132	5	8	3
Honduras	129	8	12	4
Nigeria	127	-1	2	3
Portugal	123	8	11	3
Japan	123	2	4	2
Netherlands	121	0	4	4
Russia	120	1	0	-1
United Kingdom	120	-1	3	4
Lebanon	119	6	11	4
France	118	-1	1	2

Country	Electricity intensity in 1999 (kWh per value added [thousands 1995 US \$ PPP])	Average % change in electricity intensity per year between 1994 and 1999	Average % change in electricity consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Denmark	117	-1	2	3
Zambia	115	-4	1	5
Costa Rica	113	2	6	4
Spain	112	5	9	3
Zimbabwe	106	1	5	4
Ecuador	105	7	7	-1
Armenia	103	-23	-18	7
Jordan	101	3	8	5
Cote d'Ivoire	98	5	11	6
Iran	97	-5	3	10
Germany	94	0	3	3
Nicaragua	91	8	11	3
Egypt	89	1	9	6
Trinidad and Tobago	89	3	7	4
Uruguay	86	10	13	3
Luxembourg	86	-4	2	6
South Africa	84	4	8	3
Belgium	80	1	3	2
Philippines	79	1	7	5
Paraguay	78	11	12	0
Italy	74	0	2	2
Chile	72	6	9	3
Tanzania	72	0	4	4
Romania	71	29	28	-1
Turkey	70	-1	3	4
El Salvador	68	-1	3	4
Austria	64	7	9	2
Argentina	61	6	8	3
Bolivia	61	6	11	5
Colombia	61	1	4	3
Mozambique	58	15	11	-3
Pakistan	57	1	5	4
Tunisia	57	8	14	5
Guatemala	55	1	5	5
Cameroon	54	6	6	0
Gabon	53	-3	0	4
Tajikistan	50	-5	1	11
Togo	49	1	4	2
China	46	3	12	8
Benin	46	119	130	5
Indonesia	44	18	17	0
Sri Lanka	39	-5	1	6
Mexico	37	0	2	2

Country	Electricity intensity in 1999 (kWh per value added [thousands 1995 US \$ PPP])	Average % change in electricity intensity per year between 1994 and 1999	Average % change in electricity consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Morocco	35	-3	0	3
India	34	-2	7	9
Albania	23	7	7	2
Ethiopia	21	10	20	8
Vietnam	21	2	10	7
Senegal	21	-1	5	6
Azerbaijan	20	-37	-28	16
Kenya	19	-4	-1	3
Peru	11	-7	-4	4
Nepal	11	-4	2	5
Haiti	8	116	118	2
Bangladesh	5	0	4	5

Tab. 4.9: Electricity intensity (electricity consumption per value added) in the service sector

¹Note: The electricity intensity for the United States was estimated using the energy intensity from Tab. 4.5 and the ratio between energy and electricity consumption given in Tab. 4.2 and 4.7.

Shortcomings of Tab. 4.9:

Value Added

Value added in the service sector is an indicator for the activity in this sector. However, it is only weakly correlated to electricity consumption. There are some service sectors that require a great deal of electricity per unit of value added (e.g. retail trade), and other sectors that consume very little electricity (parking, warehousing). There are also big differences among service sectors regarding the value added. While for a public museum and a gold trading firm the electricity requirement may be similar – assuming both are located in the same building –, the value added, and thus the electricity intensity, is likely to be different.

For this reason, other and more energy-related measures of activity than value added may be more useful. Such an indicator could be the number of employees, floor space, or floor space times opening hours. However, also each of those activity measures has its limitations. The number of employees is only strongly correlated with energy consumption for office equipment and hot water usage, which accounts for only 10-20 percent of overall energy demand in services (Krackeler et al., 1999). Floor space is more strongly correlated with energy consumption for space conditioning and lighting (Krackeler et al, 1999). However, floor space data is available for only a limited number of countries. Besides, particularly in warmer, developing countries, a substantial amount

of business activity occurs outdoors, often in front of homes that also serve as stores. International comparison of floor space data is therefore problematic.

The next section provides an analysis of electricity intensity using employment as a measure for activity. Both indicators of electricity intensity (electricity use per value added and electricity use per employee) should be considered to derive a better picture about electricity intensity and efficiency in the service sector.

Trends in Electricity Intensity

Table 4.9 lists in the third column the change of electricity intensity by the time. The change of electricity intensity can be the result of various factors: change in the equipment used in the service sector, managerial change in the service sector, behavioral change, economic change that leads to a higher or lower value added, structural changes within the service sector, yearly climatic fluctuations, etc. The overall change in the electricity intensity, as stated in the third column in Tab. 4.9, does, therefore, not necessarily indicate any change – positive or negative – in technological energy efficiency. The effect of structural changes can be very important, particularly in countries with a rapid economic growth, such as, for instance, most of East Asian countries.

To better monitor technological energy efficiency trends by the time, it would be necessary to leave out the influence of structural changes. This could be done by calculating the electricity intensity at constant structure of the value added between major service branches. For this, one would need, however, data about the electricity consumption and the value added in the various service branches, which was not easily obtainable for all countries.

4.7 Electricity Intensity in the Service Sector (Electricity Use per Employee)

Electricity intensity is here defined as the ratio between total electricity consumption in the service sector (in kWh) and the number of employees in the service sector.

Data sources:

For electricity consumption:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For the number of employees in the service sector:

World Bank, World Development Indicators (2002)

Methodology used to calculate the electricity intensity:

The electricity consumption in the service sectors listed above (ISIC divisions 41, 50, 51, 52, 55, 63, 64, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93 and 99, ISIC revision 3) was taken from the IEA Energy Balances database.

The number of employees in the service sectors (ISIC divisions 50 - 99, ISIC revision 3) was taken from the World Bank World Development Indicators database.

The coverage of the service sectors is not the same in both databases. The IEA definition covers the ISIC sector 41 (collection, purification and distribution of water), which is not included in the definition of the World Bank. On the other hand, the World Bank database covers the ISIC sectors 60 (land transport, transport via pipelines), 61 (water transport), 62 (air transport), and 95 (private households with an employed person), which are not included under the definition of the IEA.

Electricity intensity (electricity use per employee) in the service sector
(countries ranked from highest to lowest electricity intensity):

Country	Electricity intensity in 1999 (Final electricity consumption [kWh] per employee)	Average % change in electricity intensity per year between 1994 and 1999	Average % change in electricity consumption per year between 1994 and 1999	Average % change in labor force per year between 1994 and 1999
Norway	13032	2	4	1
United States	10180	1	3	2
Canada	10070	0	1	1
Finland	7534	2	3	0
Sweden	7502	0	1	0
Luxembourg ¹	7185	-1	2	2
Iceland ¹	6670	3	5	1
Singapore	6338	9	13	4
Japan	5818	2	4	1
Australia	5680	3	6	2
New Zealand	5399	2	4	2
Netherlands ¹	5274	3	4	1
France	4995	0	1	1
Denmark ¹	4678	1	2	1
Greece ¹	4235	6	8	2
Spain	4200	7	9	1
Germany	4161	1	3	1
United Kingdom	4144	2	3	1
Portugal	3955	12	11	-1
Korea (Rep.)	3943	7	12	5
Belgium ¹	3887	2	3	1
Slovak Republic	3747	10	14	3
Italy	3411	1	2	1
Malaysia	3384	-6	3	9
Czech Republic	3254	2	4	2
Austria	2898	8	9	1
Hungary	2884	4	4	0
Estonia	2724	-1	1	1
Panama	2666	5	9	4
Bulgaria	2389	40	41	1
Poland ¹	2265	3	6	3
Thailand	2191	0	6	6
Ukraine	2084	-6	-6	1
Latvia	2022	0	1	1
Costa Rica	1893	1	6	4
Lithuania	1881	15	17	2
Brazil ¹	1591	4	7	3

Country	Electricity intensity in 1999 (Final electricity consumption [kWh] per employee)	Average % change in electricity intensity per year between 1994 and 1999	Average % change in electricity consumption per year between 1994 and 1999	Average % change in labor force per year between 1994 and 1999
Uruguay	1560	10	13	2
Argentina ¹	1498	5	8	3
Jamaica ¹	1457	11	14	3
Russia	1348	-4	0	5
Turkey	1318	1	3	3
Trinidad and Tobago ¹	1293	4	7	3
Chile ¹	1125	6	9	3
Romania	1041	26	28	2
Moldova	984	-7	-4	3
Honduras	826	8	12	4
Egypt ¹	788	4	9	5
Mexico	781	-1	2	2
Philippines	766	1	7	5
El Salvador ¹	737	-3	3	6
China ¹	608	7	12	4
Nicaragua	585	7	11	3
Colombia	560	-1	4	5
Ecuador	538	3	7	4
Tajikistan ¹	402	-6	1	9
Sri Lanka ¹	385	-1	1	3
Pakistan	347	0	5	5
Morocco	250	-4	0	4
Indonesia ¹	235	13	17	4
Peru	113	-8	-4	4
Azerbaijan	107	-33	-28	7
Kenya	27	-4	-1	3

Tab. 4.10: Energy intensity (electricity consumption per employee) in the service sector

Notes:

¹ The number of employees in 1999 was estimated by extrapolating the available data for the number of employees from 1994 to 1998.

Comparison of Electricity Consumption per Value Added and Electricity Consumption per Employee

Comparing Tab. 4.9 and Tab. 4.10 shows a good match of the relative ranking for countries with very high electricity intensity in the service sector. However, there is a systematic difference in the ranking for two groups of countries: Countries in transition (formerly centrally planned economies in Eastern Europe and Russia) and advanced economies in Western Europe and Asia.

Countries in transition (Commonwealth of Independent States, Central and Eastern European countries) show higher electricity intensity, if intensity is defined as electricity consumption per value added, than if intensity is defined as electricity use per employee. This is explainable due to the low labor productivity in these countries.

On the other hand, some advanced economies, such as Japan, Australia, the Republic of Korea and several Western European countries, show lower electricity intensity, if intensity is defined as electricity consumption per value added, than if it is defined as electricity consumption per employee. This results from the fact that labor productivity in the service sector (value added per employee) is very high in these countries.

Apart from these differences, there are several countries that show very high electricity intensity using either of the two definitions. These are Norway, Canada, Sweden, Finland, Iceland, Singapore, and New Zealand.

In some of these countries the high electricity intensity can at least partially be attributed to the high share of electricity use in total final energy consumption. In Norway, Finland, and Singapore electricity use in 1999 accounted for 82%, 74%, and 100%, respectively, in total energy use in the sector. In Norway and Finland electricity is a popular source for space heating. These facts, together with the cold climate, explain at least partially the high electricity intensity in these Scandinavian countries.

5. Energy Intensity Indicators for the Manufacturing Sector

The manufacturing sector is here defined as the sum of the following ISIC divisions (Rev. 3):

- 15 Manufacture of food products and beverages
- 16 Manufacture of tobacco products
- 17 Manufacture of textiles
- 18 Manufacture of wearing apparel; dressing and dyeing of fur
- 19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
- 20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- 21 Manufacture of pulp, paper and paper products
- 22 Publishing, printing and reproduction of recorded media
- 23 Manufacture of coke, refined petroleum products and nuclear fuel
- 24 Manufacture of chemicals, chemical products and man-made fibers
- 25 Manufacture of rubber and plastic products
- 26 Manufacture of other non-metallic mineral products
- 27 Manufacture of basic metals
- 28 Manufacture of fabricated metal product, except machinery and equipment
- 29 Manufacture of machinery and equipment n.e.c.
- 30 Manufacture of office machinery and computers
- 31 Manufacture of electrical machinery and apparatus n.e.c.
- 32 Manufacture of radio, television and communication equipment and apparatus
- 33 Manufacture of medical, precision and optical instruments, watches and clocks
- 34 Manufacture of motor vehicles, trailers and semi-trailers
- 35 Manufacture of other transport equipment
- 36 Manufacture of furniture; manufacturing n.e.c.
- 37 Recycling

The following countries were analyzed for energy intensity in the manufacturing sector (chapter 5.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
Algeria	Armenia	Australia	Costa Rica	Albania	Iran	Canada	Argentina
Angola	Azerbaijan	New Zealand	Dominican R.	Austria	Jordan	Mexico	Bolivia
Benin	Bangladesh		El Salvador	Belarus	Lebanon	United States	Brazil
Cameroon	China		Guatemala	Belgium	Saudi Arabia		Canada
Congo (Rep.)	India		Honduras	Bulgaria	Syria		Chile
Cote d'Ivoire	Indonesia		Jamaica	Czech Rep.	Turkey		Colombia
Egypt	Japan		Nicaragua	Denmark	Yemen		Ecuador
Ethiopia	Korea, Rep.		Panama	Estonia			Paraguay
Gabon	Kyrgyzstan		Trinidad & Tob	Finland			Peru
Ghana	Malaysia			France			Uruguay
Kenya	Nepal			Germany			Venezuela
Morocco	Pakistan			Greece			
Mozambique	Philippines			Hungary			
Namibia	Singapore			Iceland			
Nigeria	Sri Lanka			Italy			
Senegal	Tajikistan			Latvia			
South Africa	Thailand			Lithuania			
Togo	Vietnam			Luxembourg			
Tunisia				Netherlands			
Zambia				Norway			
Zimbabwe				Poland			
				Portugal			
				Romania			
				Russian Fed.			
				Slovak Rep.			
				Spain			
				Sweden			
				Ukraine			
				UK			

Tab. 5.1: Analyzed countries for energy intensity in the manufacturing sector

5.1 Energy Consumption in the Manufacturing Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Albania	184	206	212	136	160	141	-3
Algeria	2633	2470	2181	2343	2317	2678	1
Angola	688	775	814	824	679	676	0
Argentina	11681	12493	13008	14234	14677	13993	4
Armenia	334	298	268	417	452	459	9
Australia	19471	19879	20169	20433	20899	20963	1
Austria	5045	5421	5541	5957	6244	5724	3
Azerbaijan	3645	3010	2423	2033	1578	1882	-11
Bahrain	1513	1608	1671	1698	1655	1606	1
Bangladesh	2872	3604	3556	3618	3552	3721	6
Belarus	6245	6272	6412	6579	6700	6628	1
Belgium	12969	12752	13927	14744	15185	15732	4
Benin	16	19	51	58	50	54	39
Bolivia	575	645	533	771	809	758	8
Bosnia and Herzegovina	40	40	43	43	44	45	2
Brazil	52576	53402	54998	58591	60132	62384	3
Brunei	89	95	103	114	93	83	-1
Bulgaria	5997	6742	6762	6314	5282	4137	-6
Cameroon	871	874	897	929	937	977	2
Canada	54434	56178	57435	58060	56714	59033	2
Chile	4127	4729	5112	6206	5829	5985	8
China	332662	349035	366512	330562	341711	303582	-2
Chinese Taipei	20424	21071	21895	22600	23761	24286	4
Colombia	6461	7016	7287	7555	7398	6815	1
Congo	25	27	25	19	12	8	-19
Congo (Dem. Rep.)	2491	2584	2647	2726	2808	2883	3
Costa Rica	452	467	465	484	459	488	2
Cote d'Ivoire	209	250	224	245	271	282	7
Croatia	1965	1889	1801	1823	1703	1784	-2
Cuba	5968	5606	6118	5939	5545	6125	1
Cyprus	384	389	426	402	416	427	2
Czech Republic	13565	13849	11922	11868	11247	9947	-6
Denmark	2597	2632	2805	2762	2672	2575	0
Dominican Republic	751	752	814	893	882	974	5
Ecuador	1072	1187	1144	1239	1236	1261	3
Egypt	9253	10560	10500	11258	13038	12172	6
El Salvador	579	590	548	632	672	695	4
Eritrea	22	24	22	23	17	20	-1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Estonia	1091	921	1008	904	784	623	-10
Ethiopia	204	224	239	263	281	274	6
Finland	10067	9944	9968	10801	11292	11593	3
France	41542	43792	44948	45433	45338	45277	2
Gabon	297	304	323	327	345	327	2
Georgia	617	376	308	407	273	260	-13
Germany	69286	69882	69383	70054	70043	68713	0
Ghana	741	766	791	793	679	698	-1
Greece	3599	3844	4103	4173	4346	4012	2
Guatemala	597	664	650	671	693	709	4
Haiti	89	131	138	209	230	285	28
Honduras	590	656	665	618	666	589	0
Hong Kong, China	1574	1427	1331	1293	1861	2302	10
Hungary	4486	4498	4749	4532	4488	4164	-1
Iceland	399	397	428	457	508	537	6
India	96003	105772	109115	104792	101306	96950	0
Indonesia	15046	15646	18577	17192	16519	18295	4
Iran	18615	20191	22414	22250	23830	24266	6
Iraq	5630	5515	5495	5811	6089	6333	2
Ireland	2274	2280	2178	2380	2397	2445	2
Israel	2175	2491	2633	2793	2851	2819	5
Italy	38659	40143	39600	40806	40518	41413	1
Jamaica	473	495	514	524	551	560	3
Japan	120729	124566	126002	128944	124285	130072	2
Jordan	633	670	679	713	768	771	4
Kazakhstan	15744	15162	13133	12476	10384	9566	-9
Kenya	1138	1125	1204	1187	1172	1211	1
Korea	42186	43717	46877	51478	50863	54435	5
Korea, DPR	42535	42104	41626	41230	39168	39560	-1
Kuwait	4695	3651	4707	4711	4805	4418	0
Kyrgyzstan	834	270	392	443	458	421	-3
Latvia	586	532	888	970	728	699	8
Lebanon	760	972	927	1165	896	953	6
Libya	2780	2940	3072	3289	3300	3214	3
Lithuania	1392	1510	1427	1334	1306	1190	-3
Luxembourg	1211	991	985	941	849	905	-5
Macedonia (Form. Yug. Rep.)	533	496	596	525	595	478	-1
Malaysia	8344	10233	10298	11376	11319	11259	7
Malta	42	42	44	39	41	43	1
Mexico	34574	36282	35159	34894	32749	31712	-2
Moldova	643	561	610	634	475	348	-10
Morocco	1415	1236	1575	1732	1669	2080	9
Mozambique	1620	1602	1553	1566	1585	1614	0

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Myanmar	757	740	788	857	861	917	4
Namibia	88	75	46	50	36	4	-32
Nepal	206	283	362	393	422	440	17
Netherlands	17745	18933	18344	18735	18656	18752	1
Netherlands Antilles	168	168	171	144	141	141	-3
New Zealand	4173	4444	4832	4736	4738	5062	4
Nicaragua	254	235	281	357	266	316	6
Nigeria	8083	7987	8387	8730	8927	9035	2
Norway	6863	7095	6923	6922	7329	7330	1
Oman	1529	1502	1239	1090	1426	2163	10
Pakistan	11920	11903	12886	12583	12577	13247	2
Panama	357	356	336	357	380	374	1
Paraguay	1167	1379	1610	1731	1568	1352	4
Peru	1839	2208	2512	2764	3014	3141	11
Philippines	3751	6599	6823	7007	7081	7227	17
Poland	21016	22979	24445	24127	21872	19081	-2
Portugal	5321	5288	5314	5715	6291	6503	4
Qatar	5763	5838	5979	6465	6489	6364	2
Romania	13353	13984	14077	12377	10018	9096	-7
Russia	156501	155225	135098	133947	127472	134628	-3
Saudi Arabia	8432	8902	9766	10532	13318	14576	12
Senegal	292	310	314	335	365	404	7
Singapore	2434	2875	3202	3951	3952	3989	11
Slovak Republic	6045	5891	6207	6041	5934	5768	-1
Slovenia	1147	1168	1323	1334	1303	1325	3
South Africa	16503	18530	20400	21302	23110	22043	6
Spain	21504	23374	22140	24648	25609	25772	4
Sri Lanka	501	713	1224	1645	1352	1693	31
Sudan	465	360	352	481	448	452	1
Sweden	12202	12905	13215	13342	12996	12380	0
Switzerland	3595	3688	3656	3714	3746	3894	2
Syria	1959	2232	2309	3014	3961	3962	16
Tajikistan	618	586	576	425	435	468	-5
Tanzania	1427	1455	1482	1505	1541	1581	2
Thailand	13749	16243	18779	17701	15430	18163	7
Togo	23	48	88	65	62	64	33
Trinidad and Tobago	2816	2933	3183	3267	3907	4396	9
Tunisia	1200	1224	1299	1285	1418	1411	3
Turkey	11273	13033	15284	16327	17201	15306	7
Turkmenistan	157	155	146	121	162	149	0
Ukraine	45418	47100	40072	39320	38299	38466	-3
United Arab Emirates	11296	11187	13841	12374	12589	12432	3
United Kingdom	38887	38442	40314	39125	38700	40590	1
United States	342783	345211	352411	351723	345088	353935	1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Uruguay	541	484	509	557	541	559	1
Uzbekistan	1519	8184	6695	5567	9156	9082	93
Venezuela	14539	15766	17219	17469	18358	15702	2
Vietnam	3020	2584	2845	2854	2703	3332	3
Yemen	139	139	156	157	157	169	4
Yugoslavia (Fed. Rep.)	2040	2188	2814	3258	3213	2624	6
Zambia	1012	1029	1036	1057	1063	1087	1
Zimbabwe	881	986	1000	935	946	966	2

Tab. 5.2: Energy consumption in the manufacturing sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Note: The manufacturing sector covered in Tab. 5.2 consists of ISIC divisions 15 – 37. It does neither include the mining and quarrying sector (ISIC div. 13 and 14) nor the construction sector (ISIC div. 45). This definition of the manufacturing sector is different from the definition of the “Total Industry” sector used by the International Energy Agency, which includes the mining, quarrying, and construction sectors.

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the manufacturing sector between 1994 and 1999:

Country	Average % change in energy consumption per year (between 1994 to 1999)
Uzbekistan	93
Benin	39
Togo	33
Sri Lanka	31
Haiti	28
Nepal	17
Philippines	17
Syria	16
Saudi Arabia	12
Peru	11
Singapore	11
Oman	10
Hong Kong, China	10
Trinidad and Tobago	9
Morocco	9
Armenia	9
Chile	8
Bolivia	8
Latvia	8
Turkey	7
Senegal	7
Cote d'Ivoire	7
Thailand	7
Malaysia	7
Nicaragua	6
Lebanon	6
Yugoslavia (Fed. Rep.)	6
Iceland	6
Ethiopia	6
South Africa	6
Egypt	6
Bangladesh	6
Iran	6
Dominican Republic	5
Israel	5
Korea	5
Indonesia	4

Country	Average % change in energy consumption per year (between 1994 to 1999)
Portugal	4
Yemen	4
Jordan	4
New Zealand	4
Belgium	4
Myanmar	4
El Salvador	4
Spain	4
Paraguay	4
Argentina	4
Guatemala	4
Chinese Taipei	4
Brazil	3
Jamaica	3
Ecuador	3
Tunisia	3
Slovenia	3
Libya	3
Congo (Dem. Rep.)	3
Finland	3
Vietnam	3
Austria	3
United Arab Emirates	3
Iraq	2
Bosnia and Herzegovina	2
Greece	2
Cameroon	2
Nigeria	2
Cyprus	2
Pakistan	2
Tanzania	2
Qatar	2
Gabon	2
Zimbabwe	2
Venezuela	2
France	2
Canada	2
Costa Rica	2
Switzerland	2
Ireland	2
Japan	2
Australia	1
Zambia	1
Italy	1

Country	Average % change in energy consumption per year (between 1994 to 1999)
Norway	1
Kenya	1
Bahrain	1
Colombia	1
Belarus	1
Sudan	1
Netherlands	1
Panama	1
United Kingdom	1
Uruguay	1
Algeria	1
Cuba	1
Malta	1
United States	1
Sweden	0
India	0
Honduras	0
Turkmenistan	0
Angola	0
Kuwait	0
Mozambique	0
Denmark	0
Germany	0
Eritrea	-1
Brunei	-1
Slovak Republic	-1
Ghana	-1
Macedonia (Form. Yug. Rep.)	-1
Hungary	-1
Korea, DPR	-1
China	-2
Poland	-2
Mexico	-2
Croatia	-2
Russia	-3
Kyrgyzstan	-3
Lithuania	-3
Albania	-3
Ukraine	-3
Netherlands Antilles	-3
Tajikistan	-5
Luxembourg	-5
Czech Republic	-6

Country	Average % change in energy consumption per year (between 1994 to 1999)
Bulgaria	-6
Romania	-7
Kazakhstan	-9
Estonia	-10
Moldova	-10
Azerbaijan	-11
Georgia	-13
Congo	-19
Namibia	-32

Tab. 5.3: Average annual change in energy consumption in the manufacturing sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Note: The manufacturing sector covered in Tab. 5.3 consists of ISIC divisions 15 – 37. It does neither include the mining and quarrying sector (ISIC div. 13 and 14) nor the construction sector (ISIC div. 45). This definition of the manufacturing sector is different from the definition of the “Total Industry” sector used by the International Energy Agency, which includes the mining, quarrying, and construction sectors.

5.2 Energy Consumption in the Manufacturing Sector by Fuel

Country	Coal [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphta [%]	Combustible Renewables and Waste [%]	Electricity [%]	Heat [%]	Other [%]
Albania	0	7	0	45	0	0	25	0	23
Algeria	0	75	1	0	0	0	15	0	9
Angola	0	66	0	10	1	14	4	0	5
Argentina	0	44	4	2	6	16	20	0	7
Armenia	0	55	0	27	0	0	12	6	0
Australia	10	29	3	12	0	10	27	0	9
Austria	2	38	2	12	0	10	24	2	11
Azerbaijan	0	55	1	26	0	0	9	8	0
Bahrain	0	95	0	0	0	0	5	0	0
Bangladesh	1	71	0	4	2	0	21	0	0
Belarus	0	27	0	9	0	0	16	40	8
Belgium	4	31	2	9	19	0	20	2	12
Benin	0	0	0	87	0	0	13	0	0
Bolivia	0	45	1	7	0	34	11	0	1
Bosnia and Herzegovina	0	0	0	0	24	0	0	0	76
Brazil	4	6	1	13	12	35	19	0	11
Brunei	0	0	0	64	7	0	29	0	0
Bulgaria	4	28	0	19	11	1	17	6	14
Cameroon	0	0	0	6	0	82	13	0	0
Canada	2	34	3	8	6	12	25	1	10
Chile	9	5	3	28	1	15	33	0	6
China	45	3	1	8	6	0	16	5	15
Chinese Taipei	16	3	1	23	15	0	27	0	14
Colombia	25	14	1	7	5	25	12	0	11
Congo (Dem. Rep.)	3	0	0	0	0	93	3	0	1
Congo (Rep.)	0	0	0	13	0	0	88	0	0
Costa Rica	0	0	4	47	0	25	24	0	0
Cote d'Ivoire	0	0	5	51	0	0	43	0	1
Croatia	3	50	1	20	0	3	14	4	7
Cuba	0	6	0	35	0	34	5	0	20
Cyprus	4	0	0	60	0	0	9	0	27
Czech Republic	19	25	1	14	7	0	16	9	9
Denmark	9	28	2	21	0	3	30	5	1
Dominican Republic	0	0	5	43	0	38	13	0	0
Ecuador	0	0	3	35	0	32	14	0	16
Egypt	0	26	1	46	0	5	16	0	5
El Salvador	0	0	5	41	0	39	14	0	1
Eritrea	0	0	0	70	0	0	30	0	0
Estonia	7	34	0	16	0	11	24	7	1

Country	Coal [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphta [%]	Combustible Renewables and Waste [%]	Electricity [%]	Heat [%]	Other [%]
Ethiopia	0	0	0	83	0	0	17	0	0
Finland	3	12	2	8	2	30	30	5	9
Former USSR	6	31	1	7	0	0	17	28	10
France	4	30	3	10	15	4	24	0	9
Gabon	0	0	0	30	3	55	12	0	0
Georgia	0	59	0	13	0	0	21	0	7
Germany	5	30	2	8	19	0	25	2	9
Ghana	0	0	1	15	0	51	34	0	0
Greece	17	8	8	31	1	5	26	0	5
Guatemala	0	0	4	53	0	27	16	0	1
Haiti	0	0	0	33	0	55	4	0	7
Honduras	6	0	2	51	0	26	12	0	3
Hong Kong, China	0	0	1	80	0	0	18	0	1
Hungary	1	40	1	9	13	0	17	11	8
Iceland	6	0	0	18	0	0	64	0	12
India	26	9	1	13	9	23	14	0	4
Indonesia	9	33	1	41	1	0	14	0	0
Iran	0	53	0	25	8	1	11	0	2
Iraq	0	65	0	27	8	0	0	0	0
Ireland	3	32	2	26	0	4	25	0	8
Israel	0	0	4	36	32	0	28	0	0
Italy	1	40	1	13	6	1	28	0	10
Jamaica	8	0	0	35	0	0	57	0	0
Japan	5	6	6	15	23	2	26	0	18
Jordan	0	0	0	79	0	0	20	0	1
Kazakhstan	59	3	0	21	0	0	8	0	9
Kenya	4	0	1	30	0	47	16	0	3
Korea	9	4	3	18	41	0	23	0	2
Korea, DPR	95	0	0	2	0	0	0	0	3
Kuwait	0	96	0	4	0	0	0	0	0
Kyrgyzstan	71	0	0	0	0	0	29	0	0
Latvia	1	26	0	24	0	24	17	4	4
Lebanon	14	0	0	68	0	0	18	0	0
Libya	0	54	0	14	31	0	0	0	0
Lithuania	0	54	0	15	0	2	17	11	1
Luxembourg	12	43	2	7	0	0	35	2	0
Macedonia (Form. Yug. Rep.)	26	1	2	18	0	0	28	22	3
Malaysia	5	24	3	44	0	1	23	0	0
Malta	0	0	0	0	0	0	93	0	7
Mexico	0	34	1	21	3	4	24	0	14
Moldova	0	83	0	3	0	0	11	0	2
Morocco	21	2	5	43	3	3	22	0	0
Mozambique	0	0	0	2	0	96	2	0	0
Myanmar	3	34	0	15	0	33	13	0	3

Country	Coal [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphta [%]	Combustible Renewables and Waste [%]	Electricity [%]	Heat [%]	Other [%]
Namibia	5	0	0	92	0	0	0	0	3
Nepal	40	0	0	24	0	24	9	0	3
Netherlands	5	43	8	1	15	0	18	5	5
Netherlands Antilles	0	0	0	71	0	0	29	0	0
New Zealand	13	46	0	4	0	10	20	0	5
Nicaragua	0	0	1	31	0	60	8	0	1
Nigeria	0	10	0	9	0	79	2	0	0
Norway	9	0	12	7	0	10	56	0	6
Oman	0	63	0	35	0	0	2	0	0
Pakistan	10	45	0	16	0	19	8	0	2
Panama	10	0	1	58	0	20	12	0	0
Paraguay	0	0	0	6	0	84	9	0	0
Peru	9	0	0	45	0	16	26	0	4
Philippines	9	0	0	30	0	49	10	0	1
Poland	30	18	0	7	4	4	17	7	13
Portugal	3	6	6	28	21	8	19	1	8
Qatar	0	78	19	0	0	0	3	0	0
Romania	1	49	0	9	5	2	19	5	11
Russia	1	27	1	5	0	1	18	36	10
Saudi Arabia	0	0	0	38	0	0	8	0	54
Senegal	0	0	0	46	0	42	12	0	0
Singapore	0	0	6	0	68	0	25	0	1
Slovak Republic	11	42	0	5	13	0	14	0	14
Slovenia	3	45	1	12	0	1	33	2	4
South Africa	48	0	1	4	0	6	33	0	7
Spain	1	29	2	10	17	4	25	0	11
Sri Lanka	0	0	1	31	0	58	10	0	0
Sudan	0	0	0	27	6	58	9	0	0
Sweden	2	2	4	11	6	34	36	2	3
Switzerland	2	17	3	27	1	10	35	3	3
Syria	0	59	0	24	3	0	14	0	0
Tajikistan	0	0	0	0	0	0	100	0	0
Tanzania	0	0	0	7	0	91	3	0	0
Thailand	19	6	4	21	0	22	17	0	12
Togo	0	0	0	72	0	0	28	0	0
Trinidad and Tobago	0	91	1	1	0	0	6	0	0
Tunisia	0	27	4	40	0	0	25	0	4
Turkey	29	10	1	24	9	0	23	0	5
Turkmenistan	0	0	0	0	0	0	100	0	0
Ukraine	12	37	0	10	0	0	13	16	13
United Arab Emirates	0	85	0	13	0	0	2	0	0
United Kingdom	4	37	5	11	8	1	22	0	11
United States	5	34	13	5	3	5	27	2	7
Uruguay	0	3	2	39	0	31	24	0	1

Country	Coal [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphta [%]	Combustible Renewables and Waste [%]	Electricity [%]	Heat [%]	Other [%]
Uzbekistan	1	81	0	2	0	0	14	0	2
Venezuela	0	63	8	11	0	2	14	0	1
Vietnam	50	0	1	29	0	0	20	0	1
Yemen	0	0	0	100	0	0	0	0	0
Yugoslavia (Fed. Rep.)	31	16	2	17	15	0	19	0	0
Zambia	6	0	1	10	0	49	32	0	1
Zimbabwe	20	0	1	7	0	9	44	0	20

Tab. 5.4: Share of various fuels in the total final energy consumption in the manufacturing sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

5.3 Energy Intensity in the Manufacturing Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the manufacturing sector (in toe) and value added in the manufacturing sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

World Bank, World Development Indicators (2002)

Methodology used to calculate the energy intensity:

The energy consumption in the manufacturing sector (ISIC divisions 15-37, Revision 3) was taken from the IEA Energy Balances database (after subtracting the energy consumption in the mining, quarrying and construction sectors from the “Total Industry” sector according to the IEA).

The value added in the manufacturing sector (ISIC divisions 15-37, Revision 3) was taken from the World Bank World Development Indicators database (the World Bank defines the ISIC divisions 15-37 as “manufacturing” sectors, whereas it defines “industry” as ISIC divisions 10-45). According to the World Bank, value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources.

The coverage of the manufacturing sector according to this work (ISIC divisions 15-37, Rev. 3) is not exactly the same in the World Bank WDI database (“manufacturing”) and the IEA databases (“Total Industry” minus mining, quarrying, and construction). The World Bank definition of the manufacturing sector covers the ISIC sectors 223 (reproduction of recorded media), 231 (manufacture of coke, refined petroleum products, and nuclear fuel), 232 (manufacture of coke oven products), and 233 (processing of nuclear fuel), which are not included in the definition of the “Total Industry” sector according to the IEA. However, the difference should not be too high.

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The use of *constant 1995 US dollars* - versus *current* US dollars - to express the value added in the industry sector of various countries allows analyzing trends in energy intensity over time within one country, leaving out the effect of price inflation.

The use of *purchasing power parities (PPPs)* - versus official exchange rates - to convert constant national currency into constant US dollars allows comparing the value added and, thus, the energy intensity, in different countries at the same time, leaving out the difference in price levels among the analyzed countries.

From the explanation of purchasing power parities in chapter 2 follows that for comparing output levels or productivity levels between countries, PPP based comparisons are in general more useful than exchange rates based comparisons. An exception would be the case where one compares the productivity of a certain industrial sector in, for example, China with the US, and the Chinese sector derives its revenues mainly from exports to the US or Europe. In that case it would be inappropriate to convert the value added of the Chinese industry or service sector into US dollars using PPPs, which represent the purchasing power in China and not in the US or Europe.

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the industry sector only. However, the difference is generally small.

Energy intensity (energy consumption per value added) in the manufacturing sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Trinidad and Tobago	3897	-1	9	11
Nigeria	1894	2	2	1
Angola	1526	-1	0	2
Zambia	1421	-1	1	3
Kyrgyzstan	1264	0	-3	-6
Mozambique	811	-14	0	17
Venezuela	799	1	2	1
Gabon	782	-4	2	7
Azerbaijan	775	-1	-11	-10
Saudi Arabia	772	10	12	1
Russian Federation [†]	755	-2	-3	-2
Ukraine	664	0	-3	-3
Syria	613	4	16	12
Belarus	579	-4	1	6
Iceland [†]	577	4	6	4
Lebanon	571	20	6	-7
Norway	548	-1	1	2
Bulgaria [†]	521	-2	-6	-4
Kenya	493	-1	1	2
New Zealand [†]	482	3	4	1
Iran	474	1	6	5
Slovak Republic	446	-5	-1	4
Canada	438	-3	2	4
Paraguay	418	4	4	0
Finland	403	-4	3	7
Luxembourg	389	-9	-5	5
Pakistan	375	0	2	2
Cameroon	375	-4	2	7
Australia	375	-1	1	3
Jamaica	356	6	3	-3
South Africa	336	4	6	2
Belgium	333	1	4	3
Estonia	331	-16	-10	7
Bolivia [†]	327	3	8	4
Egypt	323	-2	6	8
Chile	321	5	8	3
Jordan	319	1	4	4

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Sweden	319	-2	0	2
Netherlands	312	-1	1	3
Panama	310	0	1	1
India	297	-6	0	7
Czech Republic ¹	290	-6	-6	1
Brazil	285	2	3	1
Lithuania	265	-4	-3	2
United Kingdom ¹	260	0	1	1
Armenia	251	7	9	2
Latvia	248	4	8	4
Honduras	239	-4	0	4
Korea (Rep.)	237	-2	5	8
Greece	237	0	2	2
Colombia	231	2	1	-1
Portugal	225	0	4	5
Malaysia	220	0	7	8
Poland ¹	219	-9	-2	7
Ghana	216	-5	-1	4
Romania	215	-5	-7	-2
Senegal	214	0	7	7
Turkey	208	1	7	5
Spain	205	-1	4	4
Algeria	203	2	1	-1
Argentina	200	4	4	1
Singapore	199	5	11	6
France	198	-1	2	3
Mexico	196	-6	-2	5
Peru	195	10	11	2
China	191	-11	-2	10
Japan	188	0	2	1
Sri Lanka	185	22	31	7
Germany	181	-1	0	0
Nicaragua	178	4	6	3
Zimbabwe	174	3	2	0
Italy	166	0	1	2
Ecuador	166	3	3	0
Thailand	165	2	7	4
Nepal	163	11	17	5
Hungary	162	-9	-1	9
Austria	156	-1	3	4
United States ²	149		1	
Tunisia	140	-2	3	6

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Guatemala	135	1	4	3
Denmark	135	-2	0	2
Bangladesh	134	-1	6	7
Tajikistan	132	2	-5	-5
Dominican Republic	129	1	5	5
Indonesia	127	1	4	4
Morocco	126	6	9	3
El Salvador	120	-1	4	5
Philippines	117	13	17	3
Albania	116	-8	-3	5
Benin	111	30	39	5
Togo	105	22	33	7
Uruguay	104	1	1	0
Vietnam ¹	103	-7	3	11
Ethiopia	103	-1	6	7
Yemen	100	-1	4	6
Costa Rica	72	-7	2	10
Cote d'Ivoire	61	2	7	6
Congo, Rep.	9	-18	-19	-1
Namibia	4	-34	-32	1

Tab. 5.5: Energy intensity (energy consumption per value added) in the manufacturing sector

Notes:

¹ For Bolivia, Bulgaria, the Czech Republic, Iceland, New Zealand, Poland, Russia, the United Kingdom, and Vietnam the energy intensity in the manufacturing sectors consisting of ISIC divisions 15-37 was estimated by using adjusted World Bank data for value added for the industry sectors consisting of ISIC divisions 10-45.

² For the United States the data source for value added is the United Nations Industrial Development Organization (UNIDO).

Shortcomings of Tab. 5.5:

Energy Intensity

A ranking according to energy intensity for the whole manufacturing sector is biased because countries with a high share of energy intensive industry sectors, such as the chemical, petrochemical, or aluminum production sectors, will have disproportionately high overall energy intensity. Highly ranked countries, such as for example Saudi Arabia or Trinidad and Tobago, must therefore not necessarily be energy inefficient. The high ranking may simply reflect the high share of energy intensive sectors within the total manufacturing sector. On the other hand, countries that have a low ranking must not necessarily be energy efficient. The low ranking may be due to a lack of energy intensive industries in that country. One example is Thailand. Thailand is not included in the top 40 countries mainly because it has very little energy intensive industry. The sectoral analysis of chapters 6 to 15, however, shows that Thailand has several manufacturing sectors with extremely high energy intensity, such as the food, textile, or mineral industry.

To get a better ranking reflecting the “true” energy intensity, it would be necessary to adjust for the industrial structure of the countries. For this, one would need the shares of all manufacturing sub-sectors in the total manufacturing sector (based on value added) and calculate the energy intensity and energy consumption for each country with a hypothetical industry structure, which is the same for all analyzed countries, and may be the average industry structure of all analyzed countries or the structure of a specific reference country.

Such an adjustment has been made by Shipper et al. (2001) for the energy intensity of the manufacturing industry in thirteen OECD countries (Fig. 5.1).

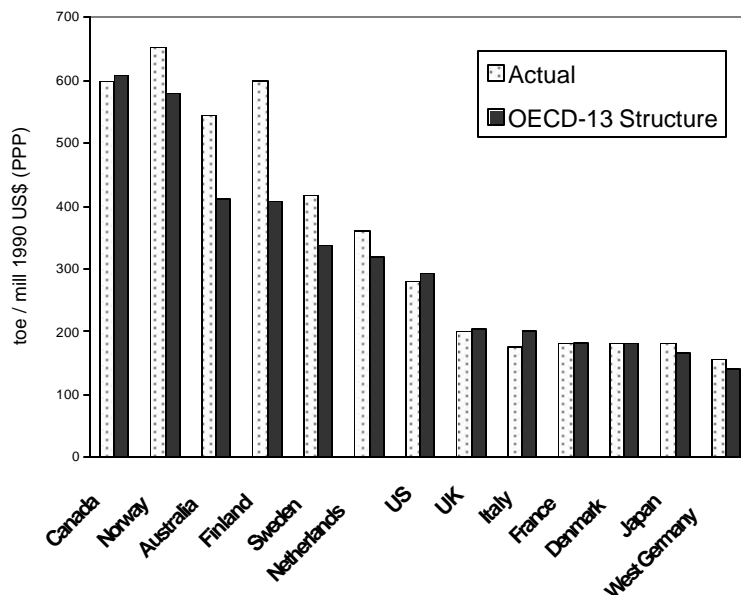


Fig. 5.1: Energy intensity in the manufacturing industry in thirteen OECD countries in 1990: actual and adjusted to OECD-13 structure (Shipper et al., 2001).

Trends in Energy Intensity

Tab. 5.5 lists in the third column the change of energy intensity by the time. The change of energy intensity can be the result of various factors: change in the equipment used in the industry sector, managerial change, behavioral change, economic change that leads to a higher or lower value added, structural changes within the industry sector, etc. The overall change in the energy intensity, as stated in the third column in Tab. 5.5, does, therefore, not necessarily indicate any change – positive or negative – in technological energy efficiency. The effect of structural changes can be very important, particularly in countries with a rapid economic growth, such as, for instance, most of East Asian countries.

To better monitor technological energy efficiency trends by the time, it would be necessary to leave out the influence of structural changes. This could be done by calculating the energy intensity at constant structure of the value added between major industrial branches. For this, one would need, however, data about the energy consumption and the value added in the various industrial branches, which was not easily obtainable for all countries.

6. Energy Intensity Indicators for the Food and Tobacco Sector

The food and tobacco sector is here defined as the sum of the following ISIC divisions (Rev. 3):

15 Manufacture of food products and beverages

- 151 Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats
- 152 Manufacture of dairy products
- 153 Manufacture of grain mill products, starches and starch products, and prepared animal feeds
- 154 Manufacture of other food products
- 155 Manufacture of beverages

16 Manufacture of tobacco products

The following countries were analyzed for energy intensity in the food and tobacco sector (chapter 6.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
	Japan Korea, Rep. Thailand			Belgium Bulgaria Denmark Finland Greece Hungary Italy Portugal Romania Spain Sweden UK		Mexico United States	Brazil

Tab. 6.1: Analyzed countries for energy intensity in the food and tobacco sector

6.1 Energy Consumption in the Food and Tobacco Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Armenia		10	10	9	5	6	-9
Australia	2380	2588	3167	3318	3202	3215	7
Austria	374	432	415	413	409	406	2
Azerbaijan	84	11	10	8	76	38	137
Belarus	412	461	587	580	622	607	9
Belgium	631	655	711	795	681	689	2
Benin			2	5	1	1	23
Bosnia and Herzegovina	10	10	11	11	11	11	2
Brazil	10838	11168	11626	12237	13544	14301	6
Bulgaria	427	412	413	361	334	326	-5
Chile	115	123	131	119	136	133	3
China	22262	24093	23221	19452	21140	17219	-4
Chinese Taipei	685	683	695	695	690	707	1
Colombia	1599	2142	2219	2244	2056	2034	6
Costa Rica	66	107	107	112	124	137	18
Cote d'Ivoire	21	27	26	28	31	34	11
Croatia	205	232	240	247	247	250	4
Cyprus	8	9	9	9	10	10	5
Czech Republic	615	657	749	758	714	810	6
Denmark	817	836	833	819	789	763	-1
Estonia	314	137	171	154	124	96	-17
Finland	441	433	391	393	424	429	0
Former USSR	13271	12521	10860	10529	10441	10727	-4
France	4027	4188	4354	4491	4619	4456	2
Georgia			12	10	9	10	-5
Germany	4580	4569	4571	4425	4402	4432	-1
Greece	363	375	563	562	596	576	11
Hungary	597	586	650	513	503	483	-4
Iceland	72	75	94	104	90	93	6
India	885	1055	886	1286	1364	1454	12
Indonesia	642	689	700	743	682	771	4
Ireland	449	463	463	473	488	475	1
Israel	74	79	84	84	89	91	4
Italy	2609	2786	2823	2847	3163	3614	7
Japan	4778	4879	5209	5171	5293	5275	2
Kazakhstan	70	54	48	43	73	237	50
Korea	1645	1783	1828	1745	1537	1503	-2
Kyrgyzstan	15	12	11	8	7	8	-11

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Latvia	112	74	279	297	203	155	39
Lithuania	239	202	213	213	215	191	-4
Luxembourg	11	11	10	11	11	13	4
Macedonia	48	36	46	43	56	46	2
Mexico	3042	3512	3485	3709	3309	2751	-1
Moldova	31	83	75	30	50	41	29
Morocco	40	42	43	45	48	51	5
Netherlands	1855	1815	1912	1842	1871	2005	2
New Zealand	168	181	183	179	180	177	1
Norway	413	399	389	387	417	390	-1
Philippines	757	795	815	823	888	870	3
Poland	2394	2553	3337	3006	2584	2018	-2
Portugal	453	413	457	505	523	491	2
Romania	1221	1470	1384	1138	819	622	-11
Russia	11517	11023	9039	8837	8740	9040	-4
Slovak Republic		360	414	399	389	379	2
Slovenia	64	63	75	87	91	92	8
South Africa	109	83	102	105	106	105	0
Spain	1888	2052	1858	1981	1966	2006	1
Sweden	527	545	560	511	496	526	0
Switzerland	136	128	160	160	147	418	39
Tajikistan	14	11	11	6	4	3	-25
Thailand	3991	4841	5573	5589	4787	5245	6
Tunisia	23	24	26	28	31	34	8
Turkey	898	896	992	1125	1136	1019	3
Ukraine	463	444	394	335	311	295	-9
United Kingdom	3648	3729	3909	3748	3693	3774	1
United States	7384	22760	23071	26271	25769	25806	44
Venezuela	316	331	331	331	331	331	1

Tab. 6.2: Energy consumption in the food and tobacco sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the food and tobacco sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Azerbaijan	84	11	10	8	76	38	137
Kazakhstan	70	54	48	43	73	237	50
United States	7384	22760	23071	26271	25769	25806	44
Switzerland	136	128	160	160	147	418	39
Latvia	112	74	279	297	203	155	39
Moldova	31	83	75	30	50	41	29
Benin			2	5	1	1	23
Costa Rica	66	107	107	112	124	137	18
India	885	1055	886	1286	1364	1454	12
Greece	363	375	563	562	596	576	11
Cote d'Ivoire	21	27	26	28	31	34	11
Belarus	412	461	587	580	622	607	9
Tunisia	23	24	26	28	31	34	8
Slovenia	64	63	75	87	91	92	8
Italy	2609	2786	2823	2847	3163	3614	7
Australia	2380	2588	3167	3318	3202	3215	7
Thailand	3991	4841	5573	5589	4787	5245	6
Iceland	72	75	94	104	90	93	6
Czech Republic	615	657	749	758	714	810	6
Colombia	1599	2142	2219	2244	2056	2034	6
Brazil	10838	11168	11626	12237	13544	14301	6
Morocco	40	42	43	45	48	51	5
Cyprus	8	9	9	9	10	10	5
Israel	74	79	84	84	89	91	4
Croatia	205	232	240	247	247	250	4
Indonesia	642	689	700	743	682	771	4
Luxembourg	11	11	10	11	11	13	4
Chile	115	123	131	119	136	133	3
Turkey	898	896	992	1125	1136	1019	3
Philippines	757	795	815	823	888	870	3
Belgium	631	655	711	795	681	689	2
France	4027	4188	4354	4491	4619	4456	2
Japan	4778	4879	5209	5171	5293	5275	2
Bosnia and Herzegovina	10	10	11	11	11	11	2
Portugal	453	413	457	505	523	491	2
Austria	374	432	415	413	409	406	2
Macedonia	48	36	46	43	56	46	2

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Netherlands	1855	1815	1912	1842	1871	2005	2
Slovak Republic		360	414	399	389	379	2
Spain	1888	2052	1858	1981	1966	2006	1
Ireland	449	463	463	473	488	475	1
New Zealand	168	181	183	179	180	177	1
Venezuela	316	331	331	331	331	331	1
United Kingdom	3648	3729	3909	3748	3693	3774	1
Chinese Taipei	685	683	695	695	690	707	1
South Africa	109	83	102	105	106	105	0
Sweden	527	545	560	511	496	526	0
Finland	441	433	391	393	424	429	0
Germany	4580	4569	4571	4425	4402	4432	-1
Norway	413	399	389	387	417	390	-1
Mexico	3042	3512	3485	3709	3309	2751	-1
Denmark	817	836	833	819	789	763	-1
Korea	1645	1783	1828	1745	1537	1503	-2
Poland	2394	2553	3337	3006	2584	2018	-2
Hungary	597	586	650	513	503	483	-4
Former USSR	13271	12521	10860	10529	10441	10727	-4
Lithuania	239	202	213	213	215	191	-4
China	22262	24093	23221	19452	21140	17219	-4
Russia	11517	11023	9039	8837	8740	9040	-4
Bulgaria	427	412	413	361	334	326	-5
Georgia			12	10	9	10	-5
Ukraine	463	444	394	335	311	295	-9
Armenia		10	10	9	5	6	-9
Kyrgyzstan	15	12	11	8	7	8	-11
Romania	1221	1470	1384	1138	819	622	-11
Estonia	314	137	171	154	124	96	-17
Tajikistan	14	11	11	6	4	3	-25

Tab. 6.3: Country ranking according to the average annual change in energy consumption in the food and tobacco sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

6.2 Energy Consumption in the Food and Tobacco Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. Gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Armenia	0	0	0	0	100	0	0
Australia	8	53	18	1	15	0	4
Austria	0	0	57	14	24	3	1
Azerbaijan	0	0	32	0	71	0	0
Belarus	0	0	4	4	15	75	1
Belgium	1	0	27	22	47	0	2
Benin	0	0	0	0	100	0	0
Brazil	0	81	1	7	9	0	0
Bulgaria	10	2	14	42	24	7	2
Chile	77	0	0	11	6	0	5
China	70	0	0	5	17	6	2
Chinese Taipei	0	0	1	61	37	0	1
Colombia	6	68	3	6	8	0	8
Costa Rica	0	0	0	64	33	0	4
Cote d'Ivoire	0	0	0	0	100	0	0
Croatia	4	0	43	30	15	6	2
Cyprus	0	0	0	0	100	0	0
Czech Republic	9	0	47	10	15	17	2
Denmark	7	1	35	26	26	4	1
Estonia	1	2	25	46	24	2	0
Finland	0	30	10	28	31	0	1
Former USSR	2	0	11	13	14	59	1
France	0	1	51	10	33	0	4
Georgia	0	0	0	0	100	0	0
Germany	3	0	45	17	27	2	6
Greece	0	29	9	40	16	0	6
Hungary	0	0	61	8	20	8	2
Iceland	0	0	0	59	33	0	8
India	0	0	0	68	32	0	0
Indonesia	0	0	0	100	0	0	0
Ireland	6	1	26	34	32	0	1
Israel	0	0	0	0	100	0	0
Italy	0	0	50	18	27	0	5
Japan	0	0	17	36	45	0	3
Kazakhstan	0	0	0	69	31	0	0
Korea	2	0	8	50	35	0	5
Kyrgyzstan	0	0	0	0	100	0	0
Latvia	3	6	31	39	17	2	2
Lithuania	1	1	22	26	22	26	3
Luxembourg	0	0	0	38	62	0	0
Macedonia	2	0	0	4	22	72	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. Gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Mexico	0	44	4	45	7	0	1
Moldova	0	0	15	15	54	0	17
Morocco	0	0	0	0	100	0	0
Netherlands	1	1	67	2	27	3	0
New Zealand	0	0	0	15	86	0	0
Norway	0	0	0	37	58	2	3
Philippines	0	0	0	73	27	0	1
Poland	55	0	11	12	16	4	3
Portugal	0	16	4	44	26	3	6
Romania	0	3	49	12	17	11	9
Russia	2	0	11	12	10	65	0
Slovak Republic	6	0	59	8	25	1	1
Slovenia	0	0	38	36	24	0	2
South Africa	0	0	0	28	48	0	25
Spain	0	0	37	27	33	0	2
Sweden	2	0	20	28	41	0	8
Switzerland	0	0	30	33	35	2	0
Tajikistan	0	0	0	0	100	0	0
Thailand	3	72	0	14	10	0	1
Tunisia	0	0	0	0	100	0	0
Turkey	47	0	8	12	28	0	5
Ukraine	0	0	0	0	100	0	0
United Kingdom	4	0	59	9	27	0	0
United States	11	0	55	8	24	2	1
Venezuela	0	100	0	0	0	0	0

Tab. 6.4: Share of various fuels in the total final energy consumption in the food and tobacco sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

6.3 Energy Intensity in the Food and Tobacco Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the food and tobacco sector (in toe) and value added in the food and tobacco sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the food and tobacco sector only.

Energy intensity (energy consumption per value added) in the food and tobacco sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Thailand	1133	61	6	-28
Denmark	241	9	-1	-5
Brazil	230	9	6	1
Greece	227	12	11	0
Bulgaria	221	3	-5	-6
Finland	205	5	0	-3
Portugal	168	16	2	-11
Sweden	168	-3	0	4
Italy	150	-2	7	12
Hungary	136	-5	-4	2
United Kingdom	136	1	1	0
Mexico	118	-1	-1	1
Belgium	118	6	2	-3
United States	112	38	44	4
Spain	111	-2	1	8
Japan	67	0	2	2
Korea, Rep.	55	-6	-2	6
Romania	37	-19	-11	11

Tab. 6.5: Energy intensity (energy consumption per value added) in the food and tobacco sector

7. Energy Intensity Indicators for the Textile and Leather Sector

The textile and leather sector is here defined as the sum of the following ISIC divisions (Rev. 3):

17 Manufacture of textiles

- 171 Spinning, weaving and finishing of textiles
- 172 Manufacture of other textiles
- 173 Manufacture of knitted and crocheted fabrics and articles

18 Manufacture of wearing apparel; dressing and dyeing of fur

- 181 Manufacture of wearing apparel, except fur apparel
- 182 Dressing and dyeing of fur; manufacture of articles of fur

19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

- 191 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness
- 192 Manufacture of footwear

The following countries were analyzed for energy intensity in the textile and leather sector (chapter 7.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
	Japan Korea, Rep. Thailand			Austria Bulgaria Czech Rep. Finland France Greece Hungary Italy Latvia Norway Portugal Spain Sweden UK		United States ¹	

¹Note: US data is based on a different industry classification system

Tab. 7.1: Analyzed countries for energy intensity in the textile and leather sector

7.1 Energy Consumption in the Textile and Leather Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Armenia		3	2	2	1	1	-21
Australia	363	372	361	367	363	356	0
Austria	143	136	138	176	217	205	8
Azerbaijan	61	23	15	10	2	2	-42
Belarus	240	220	247	253	262	252	1
Belgium	269	240	253	253	262	253	-1
Benin			10	18	3	3	-1
Brazil	1122	1092	1114	1033	1034	1005	-2
Bulgaria	162	184	170	167	165	132	-3
China	19970	21019	17873	15710	16123	13330	-7
Chinese Taipei	1700	1769	1909	2016	2115	2229	6
Colombia	424	480	500	537	538	461	2
Costa Rica	11	19	18	19	20	20	16
Cote d'Ivoire	26	34	33	35	40	42	11
Croatia	95	94	80	78	78	62	-8
Cyprus	2	2	2	2	1	1	-10
Czech Republic	473	465	331	288	289	298	-8
Denmark	60	62	66	57	53	56	-1
Estonia	66	36	38	45	52	50	-2
Finland	55	55	60	51	60	57	1
Former USSR	4269	3555	2771	2605	2441	2304	-11
France	869	922	958	919	889	867	0
Germany	1296	1151	1120	1060	1032	926	-6
Greece	186	188	243	233	215	196	2
Hungary	127	98	85	82	93	76	-9
Iceland	2	2	2	2	1	1	-10
India	2557	2542	2723	3477	3756	5428	17
Indonesia	1144	1200	1209	1271	1130	1270	2
Ireland	56	58	76	81	64	66	5
Israel	44	47	48	49	47	45	1
Italy	2407	2464	2362	2404	2509	2582	1
Japan	3089	3102	3004	2910	2711	2953	-1
Kazakhstan	31	15	13	12	6	10	-11
Korea	2565	2717	2711	2815	3013	3285	5
Kyrgyzstan	18	12	12	9	7	4	-25
Latvia	40	46	67	71	56	57	9
Lithuania	90	80	85	86	88	76	-3
Luxembourg	21	21	21	24	27	32	9
Macedonia	49	46	52	45	42	33	-7

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Moldova	112	120	143	141	131	94	-2
Morocco	46	49	51	54	57	61	6
Netherlands	189	200	210	211	217	176	-1
New Zealand	19	19	18	20	20	20	1
Norway	29	27	31	30	27	25	-3
Philippines	218	234	233	247	271	264	4
Poland	738	861	1006	852	664	505	-6
Portugal	462	458	524	544	568	563	4
Romania	453	402	425	490	489	304	-6
Russia	3487	2906	2053	1893	1760	1683	-13
Slovak Republic		203	208	190	195	177	-3
Slovenia	88	90	88	80	73	79	-2
South Africa	74	48	54	54	41	44	-8
Spain	921	990	951	1065	1059	1061	3
Sweden	64	71	73	70	71	72	2
Switzerland	166	170	112	107	111	129	-3
Tajikistan	27	24	24	17	11	14	-10
Thailand	1052	1265	1103	1056	980	1041	0
Tunisia	28	29	28	30	31	33	3
Turkey	897	1018	1154	1389	1312	1265	8
Ukraine	97	69	55	49	46	38	-17
United Kingdom	1133	1043	1018	982	977	981	-3
United States	3650	8230	8250	8861	8737	8586	26
Uzbekistan			18	15	21	23	11

Tab. 7.2: Energy consumption in the textile and leather sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the textile and leather sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
United States	3650	8230	8250	8861	8737	8586	26
India	2557	2542	2723	3477	3756	5428	17
Costa Rica	11	19	18	19	20	20	16
Uzbekistan			18	15	21	23	11
Cote d'Ivoire	26	34	33	35	40	42	11
Latvia	40	46	67	71	56	57	9
Luxembourg	21	21	21	24	27	32	9
Austria	143	136	138	176	217	205	8
Turkey	897	1018	1154	1389	1312	1265	8
Morocco	46	49	51	54	57	61	6
Chinese Taipei	1700	1769	1909	2016	2115	2229	6
Korea	2565	2717	2711	2815	3013	3285	5
Ireland	56	58	76	81	64	66	5
Portugal	462	458	524	544	568	563	4
Philippines	218	234	233	247	271	264	4
Tunisia	28	29	28	30	31	33	3
Spain	921	990	951	1065	1059	1061	3
Sweden	64	71	73	70	71	72	2
Indonesia	1144	1200	1209	1271	1130	1270	2
Colombia	424	480	500	537	538	461	2
Greece	186	188	243	233	215	196	2
Italy	2407	2464	2362	2404	2509	2582	1
Finland	55	55	60	51	60	57	1
Belarus	240	220	247	253	262	252	1
New Zealand	19	19	18	20	20	20	1
Israel	44	47	48	49	47	45	1
Thailand	1052	1265	1103	1056	980	1041	0
France	869	922	958	919	889	867	0
Australia	363	372	361	367	363	356	0
Japan	3089	3102	3004	2910	2711	2953	-1
Netherlands	189	200	210	211	217	176	-1
Denmark	60	62	66	57	53	56	-1
Belgium	269	240	253	253	262	253	-1
Benin			10	18	3	3	-1
Slovenia	88	90	88	80	73	79	-2
Estonia	66	36	38	45	52	50	-2
Moldova	112	120	143	141	131	94	-2

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Brazil	1122	1092	1114	1033	1034	1005	-2
Norway	29	27	31	30	27	25	-3
United Kingdom	1133	1043	1018	982	977	981	-3
Lithuania	90	80	85	86	88	76	-3
Slovak Republic		203	208	190	195	177	-3
Switzerland	166	170	112	107	111	129	-3
Bulgaria	162	184	170	167	165	132	-3
Poland	738	861	1006	852	664	505	-6
Romania	453	402	425	490	489	304	-6
Germany	1296	1151	1120	1060	1032	926	-6
Macedonia	49	46	52	45	42	33	-7
China	19970	21019	17873	15710	16123	13330	-7
Croatia	95	94	80	78	78	62	-8
South Africa	74	48	54	54	41	44	-8
Czech Republic	473	465	331	288	289	298	-8
Hungary	127	98	85	82	93	76	-9
Tajikistan	27	24	24	17	11	14	-10
Cyprus	2	2	2	2	1	1	-10
Iceland	2	2	2	2	1	1	-10
Kazakhstan	31	15	13	12	6	10	-11
Former USSR	4269	3555	2771	2605	2441	2304	-11
Russia	3487	2906	2053	1893	1760	1683	-13
Ukraine	97	69	55	49	46	38	-17
Armenia		3	2	2	1	1	-21
Kyrgyzstan	18	12	12	9	7	4	-25
Azerbaijan	61	23	15	10	2	2	-42

Tab. 7.3: Country ranking according to the average annual change in energy consumption in the textile and leather sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

7.2 Energy Consumption in the Textile and Leather Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Armenia	0	0	0	0	100	0	0
Australia	3	0	40	1	49	0	7
Austria	0	0	48	28	22	1	0
Azerbaijan	0	0	50	0	50	0	0
Belarus	0	0	5	1	21	72	0
Belgium	1	0	25	9	65	0	0
Benin	0	0	0	0	100	0	0
Brazil	0	9	9	27	54	0	1
Bulgaria	2	0	11	46	26	15	1
China	51	0	1	12	24	11	1
Chinese Taipei	2	0	1	62	35	0	0
Colombia	47	0	2	7	28	0	16
Costa Rica	0	0	0	35	60	0	5
Cote d'Ivoire	0	0	0	0	100	0	0
Croatia	0	0	37	26	24	13	0
Cyprus	0	0	0	0	100	0	0
Czech Republic	27	0	25	5	31	12	1
Denmark	0	0	54	7	30	5	4
Estonia	0	0	10	10	44	36	0
Finland	0	0	0	60	40	0	0
Former USSR	1	0	7	2	24	65	1
France	0	0	48	16	36	0	0
Germany	3	0	43	15	38	0	1
Greece	0	6	9	43	42	0	1
Hungary	0	0	37	11	25	28	0
Iceland	0	0	0	0	100	0	0
India	39	0	0	29	32	0	0
Indonesia	0	0	0	100	0	0	0
Ireland	0	0	0	42	50	0	8
Israel	0	0	0	0	100	0	0
Italy	0	0	47	15	36	0	2
Japan	1	2	5	62	24	0	7
Kazakhstan	0	0	0	40	60	0	0
Korea	3	0	7	47	42	0	1
Kyrgyzstan	0	0	0	0	100	0	0
Latvia	2	0	14	40	33	9	2
Lithuania	1	3	20	1	38	36	1
Luxembourg	0	0	0	0	100	0	0
Macedonia	0	0	0	9	21	70	0
Moldova	0	0	98	0	2	0	0
Morocco	0	0	0	0	100	0	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Netherlands	0	0	73	1	27	0	0
New Zealand	0	0	0	0	100	0	0
Norway	0	0	0	32	68	0	0
Philippines	0	0	0	70	29	0	1
Poland	51	0	7	5	22	14	2
Portugal	0	9	3	47	36	3	3
Romania	0	0	63	5	14	10	8
Russia	1	0	2	0	21	75	0
Slovak Republic	12	0	38	33	15	1	0
Slovenia	0	0	53	16	29	0	1
South Africa	0	0	0	18	82	0	0
Spain	0	0	50	17	32	1	0
Sweden	0	0	4	36	40	0	19
Switzerland	0	1	12	49	37	2	0
Tajikistan	0	0	0	0	100	0	0
Thailand	0	0	0	50	48	0	1
Tunisia	0	0	0	0	100	0	0
Turkey	9	0	14	24	53	0	0
Ukraine	0	0	0	0	100	0	0
United Kingdom	4	0	55	8	33	0	0
United States	6	0	39	10	41	3	2

Tab. 7.4: Share of various fuels in the total final energy consumption in the textile and leather sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

7.3 Energy Intensity in the Textile and Leather Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the textile and leather sector (in toe) and value added in the textile and leather sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the textile and leather sector only.

Energy intensity (energy consumption per value added) in the textile and leather sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Thailand	300	28	0	-20
Latvia	167	-3	9	15
Greece	162	6	2	-3
Czech Republic	158	-2	-8	-5
Sweden	155	2	2	1
Bulgaria	150	1	-3	-2
Norway	142	5	-3	-7
Austria	137	10	8	0
Japan	129	4	-1	-4
Korea, Rep.	126	5	5	1
Spain	125	-5	3	8
France	108	3	0	-3
United Kingdom	107	2	-3	-4
Portugal	105	5	4	-1
Finland	91	5	1	-2
Italy	73	-7	1	12
Hungary	48	-14	-9	6

Tab. 7.5: Energy intensity (energy consumption per value added) in the textile and leather sector

Note: The energy intensity in the textile and leather sector in the United States in 1999 is 122 toe/mill const 1995 US\$. The sources of this data are the Energy Information Administration of the U.S. Department of Energy and the U.S. Census Bureau of the U.S. Department of Commerce. However, a comparison of this data with the data in Tab. 7.5 is problematic, because the U.S. data is based on the 1997 NAICS industry classification system, which is different and not fully convertible to the international ISIC system used in this work. The energy intensity value of 122 toe/mill const 1995 US\$ for the textile and leather sector in 1999 in the US refers to the following industry sectors under NAICS:

- 313: Textile mills
- 314: Textile product mills
- 315: Apparel
- 316: Leather and Allied Products

8. Energy Intensity Indicators for the Wood and Wood Products Sector

The wood and wood products sector is here defined as the following ISIC division (Rev. 3):

20 Manufacture of wood and of products of wood and cork, except furniture;
manufacture of articles of straw and plaiting materials

201 Sawmilling and planing of wood

202 Manufacture of products of wood, cork, straw and plaiting materials

The following countries were analyzed for energy intensity in the wood and wood products sector (chapter 8.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
South Africa	Korea, Rep.			Austria Belgium Bulgaria Czech Rep. Denmark Finland France Greece Hungary Italy Latvia Norway Portugal Slovak Rep. Spain Sweden UK		Canada United States	

Tab. 8.1: Analyzed countries for energy intensity in the wood and wood products sector

8.1 Energy Consumption in the Wood and Wood Products Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Australia	188	213	405	409	410	413	21
Austria	195	249	260	251	261	209	3
Azerbaijan	4	1			86	71	-46
Belarus	217	211	224	262	306	300	7
Belgium	47	49	50	51	51	53	2
Bulgaria	106	102	66	59	52	49	-13
Canada	174	182	221	254	283	341	15
China	2398	2713	2556	2269	2209	1963	-4
Chinese Taipei	51	50	49	50	48	47	-2
Colombia	130	131	140	150	138	102	-4
Costa Rica		4	4	5	7	8	20
Cote d'Ivoire	8	10	10	11	12	13	10
Croatia	36	36	39	32	30	39	3
Cyprus	1	1	1	1	1	1	0
Czech Republic	111	104	134	109	88	99	-1
Denmark	118	120	120	135	133	120	1
Estonia	47	40	62	53	64	67	10
Finland	533	551	527	584	625	641	4
Former USSR	10500	10360	7724	7338	7444	8367	-4
France	770	791	807	824	1235	1384	14
Gabon	1	1	1	1	1	1	0
Germany	667	591	580	580	576	645	0
Greece	39	42	52	52	46	45	4
Hungary	49	53	60	44	37	33	-6
Iceland	1	1	1	1	1	1	0
Ireland	136	137	89	118	111	112	-1
Israel	10	11	11	10	9	10	0
Italy	172	183	178	190	198	336	17
Kazakhstan	7	5	5	4	1	2	-5
Korea	168	156	169	179	138	172	2
Kyrgyzstan	1	1	1	1		1	0
Latvia	38	33	112	144	133	167	55
Lithuania	23	22	23	36	40	31	9
Macedonia	3	8	14	9	3	7	55
Moldova	3	5	6	4	5	4	12
Netherlands	64	60	59	47	51	48	-5
New Zealand	533	563	571	537	567	699	6
Norway	233	233	241	245	282	255	2
Philippines	63	56	38	33	34	36	-9

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Poland	449	490	549	577	558	526	3
Portugal	119	126	156	173	161	196	11
Romania	273	209	199	245	161	164	-8
Russia	10115	10006	7263	6808	6785	7699	-4
Slovak Republic		55	63	59	56	53	-1
Slovenia	43	40	35	30	33	39	-1
South Africa	56	55	61	74	61	56	1
Spain	182	160	139	179	228	232	7
Sweden	905	936	984	1048	1036	1106	4
Switzerland	91	83	95	93	104		4
Thailand	102	99	98	94	91	108	1
Turkey	166	190	202	194	62	55	-13
Ukraine	44	34	28	27	24	24	-11
United Kingdom	18	20	25	24	25	21	4
United States	7851	12937	14762	16164	17279	18941	21

Tab. 8.2: Energy consumption in the wood and wood products sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the wood and wood products sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Latvia	38	33	112	144	133	167	55
Macedonia	3	8	14	9	3	7	55
Australia	188	213	405	409	410	413	21
United States	7851	12937	14762	16164	17279	18941	21
Costa Rica		4	4	5	7	8	20
Italy	172	183	178	190	198	336	17
Canada	174	182	221	254	283	341	15
France	770	791	807	824	1235	1384	14
Moldova	3	5	6	4	5	4	12
Portugal	119	126	156	173	161	196	11
Cote d'Ivoire	8	10	10	11	12	13	10
Estonia	47	40	62	53	64	67	10
Lithuania	23	22	23	36	40	31	9
Belarus	217	211	224	262	306	300	7
Spain	182	160	139	179	228	232	7
New Zealand	533	563	571	537	567	699	6
Sweden	905	936	984	1048	1036	1106	4
United Kingdom	18	20	25	24	25	21	4
Finland	533	551	527	584	625	641	4
Switzerland	91	83	95	93	104		4
Greece	39	42	52	52	46	45	4
Poland	449	490	549	577	558	526	3
Croatia	36	36	39	32	30	39	3
Austria	195	249	260	251	261	209	3
Belgium	47	49	50	51	51	53	2
Norway	233	233	241	245	282	255	2
Korea	168	156	169	179	138	172	2
Thailand	102	99	98	94	91	108	1
South Africa	56	55	61	74	61	56	1
Denmark	118	120	120	135	133	120	1
Israel	10	11	11	10	9	10	0
Cyprus	1	1	1	1	1	1	0
Gabon	1	1	1	1	1	1	0
Iceland	1	1	1	1	1	1	0
Kyrgyzstan	1	1	1	1		1	0
Germany	667	591	580	580	576	645	0
Slovak Republic		55	63	59	56	53	-1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Czech Republic	111	104	134	109	88	99	-1
Slovenia	43	40	35	30	33	39	-1
Ireland	136	137	89	118	111	112	-1
Chinese Taipei	51	50	49	50	48	47	-2
China	2398	2713	2556	2269	2209	1963	-4
Former USSR	10500	10360	7724	7338	7444	8367	-4
Colombia	130	131	140	150	138	102	-4
Russia	10115	10006	7263	6808	6785	7699	-4
Kazakhstan	7	5	5	4	1	2	-5
Netherlands	64	60	59	47	51	48	-5
Hungary	49	53	60	44	37	33	-6
Romania	273	209	199	245	161	164	-8
Philippines	63	56	38	33	34	36	-9
Ukraine	44	34	28	27	24	24	-11
Turkey	166	190	202	194	62	55	-13
Bulgaria	106	102	66	59	52	49	-13
Azerbaijan	4	1			86	71	-46

Tab. 8.3: Country ranking according to the average annual change in energy consumption in the wood and wood products sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

8.2 Energy Consumption in the Wood and Wood Products Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Australia	1	54	8	6	28	0	2
Austria	0	28	28	12	31	1	0
Azerbaijan	0	0	0	0	100	0	0
Belarus	0	2	25	0	12	60	0
Belgium	0	0	0	2	98	0	0
Bulgaria	0	24	0	55	20	0	0
Canada	0	0	0	100	0	0	0
China	65	0	0	6	17	11	1
Chinese Taipei	0	0	0	0	100	0	0
Costa Rica	0	0	0	25	75	0	0
Cote d'Ivoire	0	0	0	0	100	0	0
Croatia	0	54	13	10	21	0	3
Cyprus	0	0	0	0	100	0	0
Czech Republic	6	5	15	10	31	29	3
Denmark	0	55	3	15	26	0	1
Estonia	0	39	4	28	25	1	1
Finland	8	61	5	7	20	0	0
Former USSR	0	5	1	6	22	66	0
France	0	66	0	0	34	0	0
Gabon	0	0	100	0	0	0	0
Germany	0	9	18	21	50	0	2
Greece	0	62	0	11	24	0	2
Hungary	0	0	73	0	27	3	0
Iceland	0	0	0	0	100	0	0
Ireland	0	78	0	4	19	0	0
Israel	0	0	0	0	100	0	0
Italy	0	0	0	0	100	0	0
Kazakhstan	0	0	0	50	50	0	0
Korea	0	0	1	43	55	0	1
Kyrgyzstan	0	0	0	0	100	0	0
Latvia	0	71	7	9	12	1	1
Lithuania	0	23	19	6	29	23	0
Moldova	0	0	75	0	25	0	0
Netherlands	0	0	46	0	56	0	0
New Zealand	0	77	0	0	23	0	0
Norway	0	63	0	8	29	0	0
Philippines	0	0	0	47	53	0	0
Poland	30	30	4	14	20	1	0
Portugal	0	11	1	40	37	1	11
Romania	0	54	13	9	10	7	8
Russia	0	3	0	6	21	69	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Slovak Republic	11	0	43	6	32	6	2
Slovenia	0	21	21	23	36	0	0
South Africa	0	0	0	7	91	0	2
Spain	0	0	29	15	53	0	3
Sweden	0	76	0	3	21	0	0
Thailand	0	8	0	20	69	0	2
Turkey	0	0	0	0	100	0	0
Ukraine	0	0	0	0	100	0	0
United Kingdom	0	0	0	100	0	0	0
United States	1	61	8	14	14	1	1

Tab. 8.4: Share of various fuels in the total final energy consumption in the wood and wood products sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

8.3 Energy Intensity in the Wood and Wood Products Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the wood and wood products sector (in toe) and value added in the wood and wood products sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the wood and wood products sector only.

Energy intensity (energy consumption per value added) in the wood and wood products sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
France	843	12	14	2
Sweden	690	1	4	5
Norway	612	7	2	-3
United States	598	13	21	7
Slovak Republic	590	12	-1	-10
Bulgaria	578	-9	-13	-2
Finland	468	4	4	3
Latvia	339	28	55	33
Greece	270	1	4	4
Denmark	229	-1	1	3
Portugal	164	9	11	2
Austria	130	8	3	-2
Czech Republic	118	4	-1	-4
Korea, Rep.	89	2	2	1
Hungary	84	-14	-6	10
Spain	79	-4	7	12
Belgium	76	4	2	0
South Africa	59	4	1	0
Italy	51	-5	17	36
Canada	37	13	15	2
United Kingdom	7	2	4	3

Tab. 8.5: Energy intensity (energy consumption per value added) in the wood and wood products sector

9. Energy Intensity Indicators for the Paper, Pulp, and Printing Sector

The paper, pulp, and printing sector is here defined as the sum of the following ISIC divisions (Rev. 3):

21 Manufacture of pulp, paper and paper products

22 Publishing, printing and reproduction of recorded media

221 Publishing

222 Printing and service activities related to printing

223 Reproduction of recorded media

The following countries were analyzed for energy intensity in the paper, pulp, and printing sector (chapter 9.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
South Africa	Japan Korea, Rep.			Austria Belgium Bulgaria Czech Rep. Denmark Finland France Greece Hungary Italy Latvia Netherlands Norway Portugal Slovak Rep. Spain Sweden UK		Mexico United States ¹	Brazil

¹Note: US data is based on a different industry classification system

Tab. 9.1: Analyzed countries for energy intensity in the paper, pulp, and printing sector

9.1 Energy Consumption in the Paper, Pulp, and Printing Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Australia	1449	1457	1306	1334	1369	1302	-2
Austria	1143	1201	1219	1240	1272	1257	2
Belarus	37	42	28	33	46	48	8
Belgium	363	382	365	374	347	366	0
Brazil	4807	4874	5104	5129	5564	5964	4
Bulgaria	112	144	152	153	136	99	-1
Canada	16722	16866	16925	17090	17052	18135	2
Chile	762	795	806	640	852	955	6
China	11776	13090	12534	10497	10978	8957	-5
Chinese Taipei	937	988	1023	1051	996	967	1
Colombia	599	644	672	694	735	692	3
Costa Rica	7	11	11	11	11	13	15
Croatia	110	81	72	79	65	86	-3
Cyprus	1	1	1	1	1	1	0
Czech Republic	458	451	427	388	353	368	-4
Denmark	154	167	184	174	168	160	1
Estonia	27	12	78	65	46	33	84
Finland	4520	4384	4421	4944	5371	5267	3
Former USSR	360	330	379	364	341	361	0
France	3618	3721	3755	3889	3685	3759	1
Germany	3950	4665	4393	4388	4236	4441	3
Greece	122	113	137	150	140	150	5
Hungary	107	92	106	165	175	164	11
Iceland	2	2	2	2	2	2	0
India	1513	1537	1675	2151	2218	2238	9
Ireland	23	24	23	22	23	25	2
Israel	22	29	32	32	35	37	11
Italy	2327	2404	2481	2575	2639	2554	2
Japan	9476	9908	9738	9676	9428	9446	0
Kazakhstan	3	2	2	2	2	6	33
Korea	1774	1833	2039	2098	1822	2043	3
Latvia	6	6	13	11	6	8	18
Lithuania	33	42	43	47	43	37	3
Macedonia	7	6	5	4	6	6	0
Mexico	1251	1150	1183	1071	976	1021	-4
Moldova		2	1		2	2	-25
Morocco	30	32	32	34	36	39	5
Netherlands	673	636	676	701	677	740	2
New Zealand	134	114	114	85	86	87	-8
Norway	1062	1099	1128	1090	1055	1308	5

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Philippines	217	268	183	156	170	248	6
Poland	958	1245	1284	1332	1200	1149	5
Portugal	474	408	468	533	554	548	4
Romania	161	376	372	353	273	268	21
Russia	201	170	163	158	150	181	-1
Slovak Republic		292	297	270	269	240	-5
Slovenia	112	107	107	115	125	179	11
South Africa	109	92	92	97	97	152	9
Spain	1312	1414	1350	1524	1623	1609	4
Sweden	5283	5638	5630	5791	5784	5945	2
Switzerland	422	425	406	414	429	655	11
Thailand	241	271	313	312	273	360	9
Tunisia	8	8	9	8	9	9	3
Turkey	255	291	296	273	361	373	9
Ukraine	52	54	49	46	45	45	-3
United Kingdom	2630	2627	2383	2267	2217	2317	-2
United States	17325	38386	36265	36361	36146	36617	23

Tab. 9.2: Energy consumption in the paper, pulp, and printing sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according to their average annual growth rate in energy consumption in the paper, pulp, and printing sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Estonia	27	12	78	65	46	33	84
Kazakhstan	3	2	2	2	2	6	33
United States	17325	38386	36265	36361	36146	36617	23
Romania	161	376	372	353	273	268	21
Latvia	6	6	13	11	6	8	18
Costa Rica	7	11	11	11	11	13	15
Israel	22	29	32	32	35	37	11
Hungary	107	92	106	165	175	164	11
Slovenia	112	107	107	115	125	179	11
Switzerland	422	425	406	414	429	655	11
Thailand	241	271	313	312	273	360	9
South Africa	109	92	92	97	97	152	9
Turkey	255	291	296	273	361	373	9
India	1513	1537	1675	2151	2218	2238	9
Belarus	37	42	28	33	46	48	8
Philippines	217	268	183	156	170	248	6
Chile	762	795	806	640	852	955	6
Morocco	30	32	32	34	36	39	5
Greece	122	113	137	150	140	150	5
Norway	1062	1099	1128	1090	1055	1308	5
Poland	958	1245	1284	1332	1200	1149	5
Brazil	4807	4874	5104	5129	5564	5964	4
Spain	1312	1414	1350	1524	1623	1609	4
Portugal	474	408	468	533	554	548	4
Lithuania	33	42	43	47	43	37	3
Korea	1774	1833	2039	2098	1822	2043	3
Finland	4520	4384	4421	4944	5371	5267	3
Colombia	599	644	672	694	735	692	3
Tunisia	8	8	9	8	9	9	3
Germany	3950	4665	4393	4388	4236	4441	3
Sweden	5283	5638	5630	5791	5784	5945	2
Netherlands	673	636	676	701	677	740	2
Austria	1143	1201	1219	1240	1272	1257	2
Italy	2327	2404	2481	2575	2639	2554	2
Ireland	23	24	23	22	23	25	2
Canada	16722	16866	16925	17090	17052	18135	2
Denmark	154	167	184	174	168	160	1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
France	3618	3721	3755	3889	3685	3759	1
Chinese Taipei	937	988	1023	1051	996	967	1
Former USSR	360	330	379	364	341	361	0
Belgium	363	382	365	374	347	366	0
Cyprus	1	1	1	1	1	1	0
Iceland	2	2	2	2	2	2	0
Japan	9476	9908	9738	9676	9428	9446	0
Macedonia	7	6	5	4	6	6	0
Bulgaria	112	144	152	153	136	99	-1
Russia	201	170	163	158	150	181	-1
Australia	1449	1457	1306	1334	1369	1302	-2
United Kingdom	2630	2627	2383	2267	2217	2317	-2
Croatia	110	81	72	79	65	86	-3
Ukraine	52	54	49	46	45	45	-3
Mexico	1251	1150	1183	1071	976	1021	-4
Czech Republic	458	451	427	388	353	368	-4
Slovak Republic		292	297	270	269	240	-5
China	11776	13090	12534	10497	10978	8957	-5
New Zealand	134	114	114	85	86	87	-8
Moldova		2	1		2	2	-25

Tab. 9.3: Country ranking according to the average annual change in energy consumption in the paper, pulp, and printing sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

9.2 Energy Consumption in the Paper, Pulp, and Printing Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Australia	14	16	37	1	30	0	1
Austria	4	34	23	6	29	4	0
Belarus	4	0	0	42	50	0	4
Belgium	2	1	28	11	58	0	0
Brazil	1	61	3	17	16	0	0
Bulgaria	0	2	31	38	22	6	0
Canada	0	46	16	8	28	2	0
Chile	3	61	2	9	25	0	0
China	61	0	0	5	21	12	1
Chinese Taipei	26	0	0	37	36	0	1
Colombia	42	37	7	2	10	0	1
Costa Rica	0	0	0	62	38	0	0
Croatia	2	0	50	6	26	16	0
Cyprus	0	0	0	0	100	0	0
Czech Republic	17	0	22	7	41	13	0
Denmark	0	0	31	6	39	24	1
Estonia	0	42	12	15	24	3	3
Finland	0	33	18	1	40	0	7
Former USSR	1	4	55	8	26	5	1
France	5	23	38	7	27	0	0
Germany	7	1	44	5	39	1	3
Greece	0	3	4	49	27	0	17
Hungary	1	0	39	9	25	27	0
Iceland	0	0	0	0	100	0	0
India	74	0	0	0	26	0	0
Ireland	0	0	0	44	56	0	0
Israel	0	0	0	0	100	0	0
Italy	0	0	61	7	32	0	0
Japan	11	23	6	24	32	0	3
Kazakhstan	0	0	0	67	33	0	0
Korea	0	0	2	58	38	0	1
Latvia	13	25	25	0	25	13	0
Lithuania	3	0	24	0	24	43	5
Macedonia	0	0	0	0	17	83	0
Mexico	0	0	25	45	29	0	0
Moldova	0	0	0	0	100	0	0
Morocco	0	0	0	0	100	0	0
Netherlands	0	0	49	0	43	7	0
New Zealand	0	0	0	0	100	0	0
Norway	0	44	0	10	45	0	1
Philippines	0	0	0	78	21	0	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Poland	36	32	2	5	20	5	0
Portugal	0	6	1	60	31	0	1
Romania	0	21	38	15	18	6	1
Russia	0	0	100	0	0	0	0
Slovak Republic	20	0	25	31	24	0	0
Slovenia	15	0	44	15	27	0	0
South Africa	0	0	0	0	62	0	38
Spain	0	0	51	17	29	0	2
Sweden	0	59	1	8	32	0	1
Switzerland	0	16	24	18	32	10	0
Thailand	0	0	0	60	34	0	6
Tunisia	0	0	0	0	100	0	0
Turkey	2	0	13	51	33	0	1
Ukraine	0	0	0	0	100	0	0
United Kingdom	5	0	51	4	40	0	0
United States	7	15	38	4	33	2	0

Tab. 9.4: Share of various fuels in the total final energy consumption in the paper, pulp, and printing sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

9.3 Energy Intensity in the Paper, Pulp, and Printing Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the paper, pulp, and printing sector (in toe) and value added in the paper, pulp, and printing sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the paper, pulp, and printing sector only.

Energy intensity (energy consumption per value added) in the paper, pulp, and printing sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Sweden	1096	0	2	5
Finland	826	-1	3	5
Norway	798	8	5	-2
Austria	431	-3	2	7
Bulgaria	387	1	-1	0
Slovak Republic	338	-11	-5	15
France	284	0	1	1
Czech Republic	256	6	-4	-9
Brazil	227	7	4	1
Portugal	226	2	4	2
Greece	204	2	5	3
Mexico	190	-5	-4	2
Spain	163	-4	4	10
Italy	161	-7	2	11
Japan	157	-2	0	2
Korea, Rep.	139	-2	3	6
Hungary	133	5	11	5
Netherlands	103	-9	2	13
Belgium	101	1	0	0
United Kingdom	85	-5	-2	3
Denmark	80	-3	1	4
Latvia	34	-6	18	31
South Africa	29	8	9	2

Tab. 9.5: Energy intensity (energy consumption per value added) in the paper, pulp, and printing sector

Note: The energy intensity in the paper, pulp, and printing sector in the United States in 1999 is 532 toe/mill const 1995 US\$. The sources of this data are the Energy Information Administration of the U.S. Department of Energy and the U.S. Census Bureau of the U.S. Department of Commerce. However, a comparison of this data with the data in Tab. 9.5 is problematic, because the U.S. data is based on the 1997 NAICS industry classification system, which is different and not fully convertible to the international ISIC system used in this work. The energy intensity value of 532 toe/mill const 1995 US\$ for the paper, pulp, and printing sector in 1999 in the US refers to the following industry sectors under NAICS:

- 322: Paper
- 323: Printing and related support

10. Energy Intensity Indicators for the Chemical Sector

The chemical sector is here defined as the following ISIC division (Rev. 3):

24 Manufacture of chemicals, chemical products and man-made fibers

- 241 Manufacture of basic chemicals
- 242 Manufacture of other chemical products
- 243 Manufacture of man-made fibers

The following countries were analyzed for energy intensity in the chemical sector (chapter 10.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
Egypt	Bangladesh Japan Korea, Rep. Singapore Thailand			Bulgaria Czech Rep. France Greece Hungary Italy Norway Portugal Romania Slovak Rep. Spain UK	Iran Jordan	Canada Mexico United States	Brazil

Tab. 10.1: Analyzed countries for energy intensity in the chemical sector

10.1 Energy Consumption in the Chemical Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Albania		8	7	6	5	4	-16
Algeria	1385	1255	1115	1419	1367	1672	5
Angola	8	6	8	8	8	8	2
Argentina	1471	1666	1956	2060	2177	1972	6
Armenia		12	14	17	14	17	10
Australia	3031	3187	2936	2713	2858	2742	-2
Austria	883	918	967	904	942	821	-1
Azerbaijan	300	44	44	43	35	167	54
Bahrain	904	947	872	967	943	1012	3
Bangladesh	1671	1945	1913	1729	1777	1836	2
Belarus	2819	3373	3257	3223	3117	3106	2
Belgium	5033	5164	6171	6550	6680	7127	7
Bosnia and Herzegovina	15	15	16	16	16	16	1
Brazil	12341	12397	12340	14401	14219	14989	4
Brunei	6	6	6	6	6	6	0
Bulgaria	2752	3242	3533	3173	2590	1909	-6
Canada	17307	18077	18724	19122	17870	19112	2
Chile	72	66	63	84	101	115	11
China	78371	88122	98700	90233	93215	82503	2
Chinese Taipei	8678	9073	9527	9663	9715	10134	3
Colombia	1038	1069	1128	1172	1169	1108	1
Costa Rica	31	47	43	48	52	58	15
Cote d'Ivoire	14	18	18	19	22	23	11
Croatia	958	991	909	848	753	779	-4
Cuba	24	24	27	28	26	27	3
Czech Republic	1240	1494	1960	2130	2100	2380	14
Denmark	232	257	273	273	256	247	1
Egypt	1309	1432	1454	1365	1507	1775	7
Estonia	371	373	374	353	291	210	-10
Finland	1395	1477	1393	1451	1491	1543	2
Former USSR	53268	48762	41650	43464	42812	45552	-3
France	15732	16971	17145	17741	17475	17330	2
Gabon	11	11	11	11	11	11	0
Georgia	147	160	143	167	172	162	2
Germany	28887	29273	28558	29293	29360	28617	0
Greece	244	289	382	409	574	441	15
Hungary	1525	1677	1845	1988	1854	1713	3
Iceland	13	12	12	13	11	12	-1
India	16351	17703	18665	23765	25014	27944	12

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Indonesia	5988	6079	6623	6689	6453	6715	2
Iran	1959	4773	4569	4501	6452	6433	36
Iraq	538	529	513	518	536	519	-1
Ireland	724	692	680	770	783	752	1
Israel	792	895	992	1183	1284	1220	9
Italy	12363	13211	12778	13071	12016	11229	-2
Japan	40012	42400	42261	44092	41884	45286	3
Jordan	15	16	16	14	15	10	-6
Kazakhstan	319	302	270	242	58	334	75
Korea	21280	21302	22936	26847	28217	29069	7
Latvia	43	19	59	96	52	31	26
Libya	2547	2641	2774	2862	2855	2750	2
Lithuania	475	683	699	613	612	584	6
Luxembourg	85	83	74	51	51	52	-8
Macedonia	59	55	80	61	10	18	2
Malaysia	1046	2168	914	1316	1279	1108	15
Mexico	14243	14282	14107	12932	10889	11388	-4
Morocco	80	62	89	133	52	114	26
Myanmar	106	103	79	65	88	83	-3
Netherlands	10886	11756	10458	10694	10655	11324	1
New Zealand	1000	1340	1723	1776	1662	1892	15
Nigeria	328	299	303	317	340	358	2
Norway	1826	1910	1867	1837	1895	1745	-1
Pakistan	2824	2802	2979	2966	2898	3301	3
Philippines	194	208	222	224	235	355	14
Poland	6084	6989	6922	6980	6896	6247	1
Portugal	1900	1979	1705	1889	2070	2113	3
Qatar	4904	4987	5067	5496	5503	5383	2
Romania	4769	5378	5238	4075	2682	2891	-8
Russia	47806	41471	34566	36600	36217	38795	-4
Saudi Arabia	4661	4661	4829	6057	7788	7863	12
Singapore	1637	2026	2360	3003	3003	3005	14
Slovak Republic	1222	2080	2237	2186	2349	2207	15
Slovenia	123	218	253	264	239	228	17
South Africa	4430	6137	6288	6075	6565	6295	8
Spain	5966	7918	7039	7765	8179	8146	7
Sudan	25	25	25	25	25	26	1
Sweden	1821	1875	1998	2056	1913	1492	-3
Switzerland	635	683	738	731	736	691	2
Syria	62	109	113	119	124	127	18
Tajikistan	19	20	19	12	19	17	2
Thailand	1623	1485	2690	2409	2205	3646	24
Togo	4	7	7	6	5	5	9
Trinidad and Tobago	2062	2111	2292	2293	2929	3311	10

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Tunisia	10	13	12	14	13	14	8
Turkey	3116	3356	3410	3405	3369	2960	-1
Turkmenistan	51	50	47	39	53	48	0
Ukraine	919	863	724	651	620	554	-10
United Arab Emirates	9030	9253	12403	10838	11011	10621	4
United Kingdom	14187	13888	13959	13711	13975	14839	1
United States	79699	155911	161230	151043	146297	152365	19
Uzbekistan		1392	1433	1408	1551	1526	2
Venezuela	3809	4591	5619	5796	5218	5128	7
Yugoslavia (Fed. Rep.)	200	220	278	451	509	431	19

Tab. 10.2: Energy consumption in the chemical sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the chemical sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Kazakhstan	319	302	270	242	58	334	75
Azerbaijan	300	44	44	43	35	167	54
Iran	1959	4773	4569	4501	6452	6433	36
Latvia	43	19	59	96	52	31	26
Morocco	80	62	89	133	52	114	26
Thailand	1623	1485	2690	2409	2205	3646	24
Yugoslavia (Fed. Rep.)	200	220	278	451	509	431	19
United States	79699	155911	161230	151043	146297	152365	19
Syria	62	109	113	119	124	127	18
Slovenia	123	218	253	264	239	228	17
Malaysia	1046	2168	914	1316	1279	1108	15
Slovak Republic	1222	2080	2237	2186	2349	2207	15
Greece	244	289	382	409	574	441	15
Costa Rica	31	47	43	48	52	58	15
New Zealand	1000	1340	1723	1776	1662	1892	15
Czech Republic	1240	1494	1960	2130	2100	2380	14
Philippines	194	208	222	224	235	355	14
Singapore	1637	2026	2360	3003	3003	3005	14
Saudi Arabia	4661	4661	4829	6057	7788	7863	12
India	16351	17703	18665	23765	25014	27944	12
Chile	72	66	63	84	101	115	11
Cote d'Ivoire	14	18	18	19	22	23	11
Armenia		12	14	17	14	17	10
Trinidad and Tobago	2062	2111	2292	2293	2929	3311	10
Israel	792	895	992	1183	1284	1220	9
Togo	4	7	7	6	5	5	9
South Africa	4430	6137	6288	6075	6565	6295	8
Tunisia	10	13	12	14	13	14	8
Belgium	5033	5164	6171	6550	6680	7127	7
Spain	5966	7918	7039	7765	8179	8146	7
Venezuela	3809	4591	5619	5796	5218	5128	7
Egypt	1309	1432	1454	1365	1507	1775	7
Korea	21280	21302	22936	26847	28217	29069	7
Argentina	1471	1666	1956	2060	2177	1972	6
Lithuania	475	683	699	613	612	584	6
Algeria	1385	1255	1115	1419	1367	1672	5

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
United Arab Emirates	9030	9253	12403	10838	11011	10621	4
Brazil	12341	12397	12340	14401	14219	14989	4
Pakistan	2824	2802	2979	2966	2898	3301	3
Chinese Taipei	8678	9073	9527	9663	9715	10134	3
Hungary	1525	1677	1845	1988	1854	1713	3
Japan	40012	42400	42261	44092	41884	45286	3
Cuba	24	24	27	28	26	27	3
Portugal	1900	1979	1705	1889	2070	2113	3
Bahrain	904	947	872	967	943	1012	3
Georgia	147	160	143	167	172	162	2
Uzbekistan		1392	1433	1408	1551	1526	2
Indonesia	5988	6079	6623	6689	6453	6715	2
Belarus	2819	3373	3257	3223	3117	3106	2
Macedonia	59	55	80	61	10	18	2
Bangladesh	1671	1945	1913	1729	1777	1836	2
Tajikistan	19	20	19	12	19	17	2
Finland	1395	1477	1393	1451	1491	1543	2
Canada	17307	18077	18724	19122	17870	19112	2
France	15732	16971	17145	17741	17475	17330	2
Qatar	4904	4987	5067	5496	5503	5383	2
Nigeria	328	299	303	317	340	358	2
Switzerland	635	683	738	731	736	691	2
Angola	8	6	8	8	8	8	2
Libya	2547	2641	2774	2862	2855	2750	2
China	78371	88122	98700	90233	93215	82503	2
Denmark	232	257	273	273	256	247	1
Colombia	1038	1069	1128	1172	1169	1108	1
Bosnia and Herzegovina	15	15	16	16	16	16	1
Netherlands	10886	11756	10458	10694	10655	11324	1
Ireland	724	692	680	770	783	752	1
United Kingdom	14187	13888	13959	13711	13975	14839	1
Poland	6084	6989	6922	6980	6896	6247	1
Sudan	25	25	25	25	25	26	1
Turkmenistan	51	50	47	39	53	48	0
Brunei	6	6	6	6	6	6	0
Gabon	11	11	11	11	11	11	0
Germany	28887	29273	28558	29293	29360	28617	0
Iraq	538	529	513	518	536	519	-1
Norway	1826	1910	1867	1837	1895	1745	-1
Turkey	3116	3356	3410	3405	3369	2960	-1
Iceland	13	12	12	13	11	12	-1
Austria	883	918	967	904	942	821	-1
Italy	12363	13211	12778	13071	12016	11229	-2

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Australia	3031	3187	2936	2713	2858	2742	-2
Former USSR	53268	48762	41650	43464	42812	45552	-3
Myanmar	106	103	79	65	88	83	-3
Sweden	1821	1875	1998	2056	1913	1492	-3
Russia	47806	41471	34566	36600	36217	38795	-4
Croatia	958	991	909	848	753	779	-4
Mexico	14243	14282	14107	12932	10889	11388	-4
Bulgaria	2752	3242	3533	3173	2590	1909	-6
Jordan	15	16	16	14	15	10	-6
Romania	4769	5378	5238	4075	2682	2891	-8
Luxembourg	85	83	74	51	51	52	-8
Ukraine	919	863	724	651	620	554	-10
Estonia	371	373	374	353	291	210	-10
Albania		8	7	6	5	4	-16

Tab. 10.3: Country ranking according to the average annual change in energy consumption in the chemical sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

10.2 Energy Consumption in the Chemical Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphtha [%]	Ethane [%]	Electricity [%]	Heat [%]	Other [%]
Algeria	0	0	89	0	0	0	8	2	0	0
Angola	0	0	0	0	0	100	0	0	0	0
Argentina	0	0	11	27	0	43	19	0	0	0
Armenia	0	0	0	0	0	0	0	100	0	0
Australia	2	6	38	13	1	0	16	14	0	10
Austria	3	11	57	0	4	0	0	22	2	1
Azerbaijan	0	0	15	0	65	0	0	20	0	0
Bahrain	0	0	100	0	0	0	0	0	0	0
Bangladesh	0	0	100	0	0	0	0	0	0	0
Belarus	0	0	37	0	6	0	0	12	29	15
Belgium	0	0	33	4	3	44	0	15	2	0
Bosnia and Herzegovina	0	0	0	0	0	100	0	0	0	0
Brazil	1	5	12	0	10	51	0	9	0	12
Brunei	0	0	0	0	0	100	0	0	0	0
Bulgaria	3	0	30	0	11	25	0	8	10	13
Canada	0	0	41	7	1	20	22	9	1	0
Chile	0	0	31	0	0	0	0	42	0	27
China	30	0	11	1	6	25	0	13	8	6
Chinese Taipei	13	0	3	0	17	37	0	20	0	10
Colombia	9	4	36	1	4	28	0	12	0	6
Costa Rica	0	0	0	0	57	3	0	40	0	0
Cote d'Ivoire	0	0	0	0	0	0	0	100	0	0
Croatia	0	0	73	1	7	0	11	6	2	0
Cuba	0	0	0	0	0	0	0	100	0	0
Cyprus	0	0	0	0	0	0	0	100	0	0
Czech Rep.	17	0	9	5	18	30	0	12	7	2
Denmark	5	0	34	1	11	0	0	40	9	0
Egypt	0	0	100	0	0	0	0	0	0	0
Estonia	0	0	76	0	2	0	0	17	5	0
Finland	2	31	4	8	11	18	0	24	0	2
Former USSR	0	0	44	3	2	0	0	10	29	11
France	2	0	25	4	10	41	0	12	0	6
Gabon	0	0	0	0	0	100	0	0	0	0
Georgia	0	0	100	0	0	0	0	0	0	0
Germany	2	0	24	3	6	46	0	15	1	2
Greece	0	0	36	13	20	6	0	24	0	2
Hungary	0	0	32	1	7	32	0	15	14	0
Iceland	0	0	0	0	0	0	0	100	0	0
India	8	0	32	0	18	30	0	11	0	0
Indonesia	0	0	82	0	15	3	0	0	0	0
Iran	0	0	71	0	0	29	0	0	0	0
Iraq	0	0	0	0	0	100	0	0	0	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphtha [%]	Ethane [%]	Electricity [%]	Heat [%]	Other [%]
Ireland	0	0	72	1	7	0	0	11	0	10
Israel	0	0	0	9	0	76	0	14	0	1
Italy	0	0	37	2	16	24	0	16	0	6
Japan	1	0	3	5	4	67	0	12	0	7
Jordan	0	0	0	0	0	0	0	100	0	0
Kazakhstan	0	0	0	0	83	0	0	18	0	0
Korea	1	0	1	4	6	78	0	9	0	1
Latvia	0	3	16	0	13	0	0	29	35	3
Libya	0	0	63	0	0	37	0	0	0	0
Lithuania	0	0	91	0	1	0	0	7	2	0
Luxembourg	0	0	0	6	8	0	0	52	33	2
Macedonia	0	0	0	0	0	0	0	28	72	0
Malaysia	0	0	91	9	0	0	0	0	0	0
Mexico	0	0	49	0	12	7	25	6	0	0
Moldova	0	0	0	0	0	0	0	100	0	0
Morocco	0	0	0	0	0	66	0	33	0	1
Myanmar	0	0	100	0	0	0	0	0	0	0
Netherlands	0	0	41	13	0	25	0	9	7	5
New Zealand	0	1	98	0	0	0	0	1	0	0
Nigeria	0	0	100	0	0	0	0	0	0	0
Norway	8	0	0	44	5	0	7	34	0	1
Pakistan	0	0	94	0	6	0	0	0	0	0
Philippines	3	0	0	0	71	0	0	21	0	5
Poland	19	4	28	1	6	11	0	11	10	9
Portugal	0	2	1	2	13	68	0	9	2	4
Qatar	0	0	78	22	0	0	0	0	0	0
Romania	4	0	54	0	3	14	0	9	6	9
Russia	0	0	43	4	1	0	0	9	32	11
Singapore	0	0	0	8	0	90	0	2	0	0
Slovak Republic	3	0	54	0	1	35	0	6	0	2
Slovenia	0	0	82	0	3	0	0	15	0	0
South Africa	92	0	0	0	0	0	0	3	0	4
Spain	1	0	22	3	5	56	0	11	0	1
Sudan	0	0	0	0	0	100	0	0	0	0
Sweden	0	1	3	8	3	49	0	35	0	0
Switzerland	0	6	26	16	12	5	0	30	4	0
Syria	0	0	0	0	0	100	0	0	0	0
Tajikistan	0	0	0	0	0	0	0	100	0	0
Thailand	0	3	4	15	13	0	13	15	0	37
Togo	0	0	0	0	0	0	0	100	0	0
Trinidad and Tobago	0	0	100	0	0	0	0	0	0	0
Tunisia	0	0	0	0	0	0	0	100	0	0
Turkey	1	0	11	0	27	50	0	11	0	0
Turkmenistan	0	0	0	0	0	0	0	100	0	0

Country	Coal [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	LPG [%]	Oil [%]	Naphtha [%]	Ethane [%]	Electricity [%]	Heat [%]	Other [%]
Ukraine	0	0	0	0	0	0	0	100	0	0
United Arab Emirates	0	0	100	0	0	0	0	0	0	0
United Kingdom	3	0	34	8	8	21	12	12	0	2
United States	3	0	30	29	2	8	12	14	2	0
Uzbekistan	0	0	92	0	0	0	0	0	0	8
Venezuela	0	0	76	21	0	0	0	4	0	0
Yugoslavia (Fed. Rep.)	0	0	0	0	0	92	0	8	0	0

Tab. 10.4: Share of various fuels in the total final energy consumption in the chemical sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

10.3 Energy Intensity in the Chemical Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the chemical sector (in toe) and value added in the chemical sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the chemical sector only.

Energy intensity (energy consumption per value added) in the chemical sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Bulgaria	6922	40	-6	-30
Slovak Republic	4183	23	15	-7
Norway	1926	3	-1	-3
Czech Republic	1383	26	14	-9
Canada	1336	0	2	2
Portugal	1284	3	3	0
Thailand	1195	53	24	-48
Bangladesh	1075	7	2	-4
Romania	1042	-7	-8	1
Korea, Rep.	990	0	7	6
Mexico	802	-8	-4	4
France	728	-1	2	3
Singapore	727	-4	14	22
United Kingdom	726	2	1	-1
Spain	722	-1	7	8
United States	705	20	19	-1
Japan	633	1	3	2
Hungary	598	-6	3	11
Italy	567	-6	-2	5
Iran	536	36	36	10
Greece	442	16	15	-2
Egypt	415	-21	7	39
Brazil	375	5	4	3
Jordan	22	-12	-6	8

Tab. 10.5: Energy intensity (energy consumption per value added) in the chemical sector

11. Energy Intensity Indicators for the Non-metallic Minerals Sector

The non-metallic minerals sector is here defined as the following ISIC division (Rev. 3):

26 Manufacture of other non-metallic mineral products

261 Manufacture of glass and glass products
269 Manufacture of non-metallic mineral products n.e.c.

The following countries were analyzed for energy intensity in the non-metallic mineral sector (chapter 11.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
South Africa	Bangladesh Japan Korea, Rep. Philippines Thailand			Austria Belgium Bulgaria Czech Rep. Finland France Greece Hungary Italy Ireland Latvia Netherlands Norway Portugal Romania Slovak Rep. Spain Sweden UK	Jordan Oman	Mexico United States	Brazil Peru

Tab. 11.1: Analyzed countries for energy intensity in the non-metallic mineral sector

11.1 Energy Consumption in the Non-metallic Mineral Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Armenia		8	7	8	8	6	-6
Australia	2022	2071	1961	2003	2028	2062	0
Austria	660	681	694	711	680	626	-1
Azerbaijan	12	7	7	7	7	4	-17
Bangladesh	29	321	176	323	93	46	185
Belarus	435	413	518	557	599	594	7
Belgium	1352	1315	1246	1211	1184	1124	-4
Benin			23	21	3	3	-31
Brazil	4564	4901	5533	6055	6279	6383	7
Bulgaria	848	976	919	801	609	506	-9
Canada	1240	1301	1240	1262	1304	1406	3
Chile	268	312	307	325	278	263	0
China	76563	79566	84545	73743	76114	63662	-3
Chinese Taipei	3541	3402	3252	3029	2934	2732	-5
Colombia	1853	1394	1464	1535	1550	1414	-5
Croatia	325	294	317	352	367	401	5
Cyprus	219	212	240	206	208	212	0
Czech Republic	1252	1347	1271	1273	1204	1170	-1
Denmark	566	522	526	568	548	490	-3
Estonia	153	174	157	117	114	84	-10
Finland	819	669	378	403	469	503	-6
Former USSR	3259	8470	8947	10675	9444	9926	36
France	3540	3686	3626	3607	3749	4176	3
Germany	7330	7934	7682	7543	7484	7310	0
Greece	1317	1365	1311	1349	1323	1166	-2
Hungary	649	590	592	587	648	570	-2
Iceland	16	9	7	11	11	16	7
India	7568	7498	7355	9247	8713	9792	6
Indonesia	2380	2372	4401	2158	2022	2551	11
Ireland	224	257	240	268	264	282	5
Israel	46	52	61	67	75	73	10
Italy	6756	6899	6801	6924	7271	7955	3
Jamaica	33	34	39	34	44	44	7
Japan	11595	11838	11721	11541	10393	10336	-2
Jordan	34	34	33	31	26	25	-6
Kazakhstan					31	46	48
Kenya	76	59	54	56	46	45	-9
Korea	5404	5552	6062	6171	4654	4925	-1
Kyrgyzstan				13	15	10	-9
Latvia	33	100	109	91	83	80	37

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Lebanon	74	119	132	132	132	132	14
Lithuania	254	214	205	205	197	173	-7
Luxembourg	125	99	106	93	87	89	-6
Macedonia	25	26	38	33	64	73	29
Mexico	3380	3126	3008	3068	3277	3350	0
Moldova	116	135	148	139	133	97	-2
Morocco	50	53	56	59	63	66	6
Netherlands	904	803	865	868	816	834	-1
New Zealand	20	21	20	21	21	21	1
Nigeria	43	6	6	6	6	6	-17
Norway	345	365	379	366	399	350	1
Oman	52	50	52	47	87	160	32
Pakistan	2792	2625	3141	2966	2829	2902	1
Peru		2	2	2	2	2	0
Philippines	1132	1226	1257	1353	1289	1200	1
Poland	3272	3366	3528	3374	3110	2768	-3
Portugal	1396	1409	1544	1606	1852	2037	8
Qatar	126	125	126	134	132	110	-2
Romania	1182	1120	1207	1158	1033	969	-4
Russia	1889	7135	7543	9299	8009	8592	60
Slovak Republic		497	541	538	487	492	0
Slovenia	112	81	200	212	200	196	24
South Africa	1395	1337	1103	1012	1136	1133	-4
Spain	4037	4150	4345	4915	5054	5210	5
Sweden	455	510	484	456	456	439	-1
Switzerland	512	447	351	412	409	426	-3
Tanzania	1	1	1	1	1	1	0
Thailand	3611	3989	4815	4351	3088	3544	1
Trinidad and Tobago	86	82	104	101	104	109	5
Tunisia	76	76	76	77	79	79	1
Turkey	745	809	914	1006	989	1038	7
Ukraine	365	284	248	234	243	235	-8
United Kingdom	2843	2708	2782	2609	2465	2522	-2
United States	10229	21945	22273	23307	19887	20308	22
Uzbekistan			6	5	4	4	-12
Venezuela	974	946	1167	1137	2279	1204	14

Tab. 11.2: Energy consumption in the non-metallic minerals sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the non-metallic minerals sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Bangladesh	29	321	176	323	93	46	185
Russia	1889	7135	7543	9299	8009	8592	60
Kazakhstan					31	46	48
Latvia	33	100	109	91	83	80	37
Former USSR	3259	8470	8947	10675	9444	9926	36
Oman	52	50	52	47	87	160	32
Macedonia	25	26	38	33	64	73	29
Slovenia	112	81	200	212	200	196	24
United States	10229	21945	22273	23307	19887	20308	22
Lebanon	74	119	132	132	132	132	14
Venezuela	974	946	1167	1137	2279	1204	14
Indonesia	2380	2372	4401	2158	2022	2551	11
Israel	46	52	61	67	75	73	10
Portugal	1396	1409	1544	1606	1852	2037	8
Iceland	16	9	7	11	11	16	7
Brazil	4564	4901	5533	6055	6279	6383	7
Turkey	745	809	914	1006	989	1038	7
Belarus	435	413	518	557	599	594	7
Jamaica	33	34	39	34	44	44	7
India	7568	7498	7355	9247	8713	9792	6
Morocco	50	53	56	59	63	66	6
Trinidad and Tobago	86	82	104	101	104	109	5
Spain	4037	4150	4345	4915	5054	5210	5
Ireland	224	257	240	268	264	282	5
Croatia	325	294	317	352	367	401	5
France	3540	3686	3626	3607	3749	4176	3
Italy	6756	6899	6801	6924	7271	7955	3
Canada	1240	1301	1240	1262	1304	1406	3
Thailand	3611	3989	4815	4351	3088	3544	1
Philippines	1132	1226	1257	1353	1289	1200	1
Pakistan	2792	2625	3141	2966	2829	2902	1
New Zealand	20	21	20	21	21	21	1
Tunisia	76	76	76	77	79	79	1
Norway	345	365	379	366	399	350	1
Australia	2022	2071	1961	2003	2028	2062	0
Chile	268	312	307	325	278	263	0
Germany	7330	7934	7682	7543	7484	7310	0
Peru		2	2	2	2	2	0

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Tanzania	1	1	1	1	1	1	0
Slovak Republic		497	541	538	487	492	0
Mexico	3380	3126	3008	3068	3277	3350	0
Cyprus	219	212	240	206	208	212	0
Sweden	455	510	484	456	456	439	-1
Austria	660	681	694	711	680	626	-1
Korea	5404	5552	6062	6171	4654	4925	-1
Czech Republic	1252	1347	1271	1273	1204	1170	-1
Netherlands	904	803	865	868	816	834	-1
Japan	11595	11838	11721	11541	10393	10336	-2
Greece	1317	1365	1311	1349	1323	1166	-2
Hungary	649	590	592	587	648	570	-2
United Kingdom	2843	2708	2782	2609	2465	2522	-2
Moldova	116	135	148	139	133	97	-2
Qatar	126	125	126	134	132	110	-2
Denmark	566	522	526	568	548	490	-3
Switzerland	512	447	351	412	409	426	-3
Poland	3272	3366	3528	3374	3110	2768	-3
China	76563	79566	84545	73743	76114	63662	-3
South Africa	1395	1337	1103	1012	1136	1133	-4
Belgium	1352	1315	1246	1211	1184	1124	-4
Romania	1182	1120	1207	1158	1033	969	-4
Colombia	1853	1394	1464	1535	1550	1414	-5
Chinese Taipei	3541	3402	3252	3029	2934	2732	-5
Jordan	34	34	33	31	26	25	-6
Armenia		8	7	8	8	6	-6
Luxembourg	125	99	106	93	87	89	-6
Finland	819	669	378	403	469	503	-6
Lithuania	254	214	205	205	197	173	-7
Ukraine	365	284	248	234	243	235	-8
Bulgaria	848	976	919	801	609	506	-9
Kyrgyzstan				13	15	10	-9
Kenya	76	59	54	56	46	45	-9
Estonia	153	174	157	117	114	84	-10
Uzbekistan			6	5	4	4	-12
Azerbaijan	12	7	7	7	7	4	-17
Nigeria	43	6	6	6	6	6	-17
Benin			23	21	3	3	-31

Tab.11.3: Country ranking according to the average annual change in energy consumption in the non-metallic minerals sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

11.2 Energy Consumption in the Non-metallic Minerals Sector by Fuel

Country	Coal [%]	Combustible Renewables and Waste [%]	Natural Gas [%]	Oil [%]	Petroleum Coke [%]	Electricity [%]	Heat [%]	Other [%]
Armenia	0	0	0	0	0	100	0	0
Australia	25	1	54	2	0	14	0	4
Austria	12	1	48	15	0	18	0	6
Azerbaijan	0	0	0	0	0	100	0	0
Bangladesh	100	0	0	0	0	0	0	0
Belarus	0	0	54	0	0	16	30	0
Belgium	24	0	37	14	6	19	0	0
Benin	0	0	0	67	0	33	0	0
Brazil	3	31	3	22	24	10	0	7
Bulgaria	13	0	48	27	0	11	0	1
Canada	45	0	21	5	16	12	0	1
Chile	56	0	0	27	0	13	0	3
China	77	0	0	9	0	9	0	4
Chinese Taipei	59	0	8	16	2	14	0	2
Colombia	49	1	26	4	0	8	0	13
Croatia	9	0	41	30	3	12	0	3
Cyprus	8	0	0	31	54	7	0	0
Czech Republic	16	0	50	12	0	16	4	3
Denmark	33	0	30	12	0	15	0	10
Estonia	57	1	20	5	0	15	1	0
Finland	39	1	29	8	6	15	0	4
Former USSR	5	0	48	7	0	14	25	1
France	5	0	40	17	16	20	0	3
Germany	11	0	38	12	4	17	0	17
Greece	54	0	2	10	17	15	0	2
Hungary	5	0	54	24	0	14	2	1
India	75	0	0	10	0	15	0	0
Indonesia	43	0	2	54	0	0	0	0
Ireland	13	0	10	14	43	18	0	2
Israel	0	0	0	0	0	100	0	0
Italy	7	3	42	12	20	14	0	2
Jamaica	100	0	0	0	0	0	0	0
Japan	41	0	3	24	7	18	0	6
Jordan	0	0	0	0	0	100	0	0
Kazakhstan	0	0	0	33	0	67	0	0
Kenya	100	0	0	0	0	0	0	0
Korea	60	0	3	16	2	16	0	4
Kyrgyzstan	0	0	0	0	0	100	0	0
Latvia	1	4	20	64	0	10	1	0
Lebanon	100	0	0	0	0	0	0	0
Lithuania	0	2	24	58	0	11	2	2

Country	Coal [%]	Combustible Renewables and Waste [%]	Natural Gas [%]	Oil [%]	Petroleum Coke [%]	Electricity [%]	Heat [%]	Other [%]
Luxembourg	88	0	0	11	0	0	0	1
Macedonia	0	0	5	51	23	14	4	3
Mexico	0	0	25	61	0	13	0	1
Moldova	0	0	91	1	0	7	0	1
Morocco	0	0	0	0	0	100	0	0
Netherlands	4	0	72	5	0	16	0	4
New Zealand	0	0	0	0	0	100	0	0
Nigeria	100	0	0	0	0	0	0	0
Norway	53	1	0	10	3	20	0	14
Oman	0	0	100	0	0	0	0	0
Pakistan	47	0	6	47	0	0	0	0
Philippines	58	0	0	33	0	9	0	1
Poland	52	0	21	7	0	10	2	8
Portugal	11	16	16	18	18	9	0	11
Qatar	0	0	100	0	0	0	0	0
Romania	1	0	61	17	0	16	2	3
Russia	5	0	50	6	0	11	27	1
Slovak Republic	12	0	55	4	0	17	0	11
Slovenia	3	0	52	17	0	20	0	8
South Africa	74	0	0	7	0	8	0	11
Spain	3	2	44	5	32	15	0	1
Sweden	26	2	4	26	0	22	0	20
Switzerland	16	26	7	31	2	17	0	0
Tanzania	100	0	0	0	0	0	0	0
Thailand	72	5	0	12	0	10	0	1
Trinidad and Tobago	0	0	100	0	0	0	0	0
Tunisia	0	0	0	0	0	100	0	0
Turkey	2	0	34	5	0	54	0	5
Ukraine	0	0	0	0	0	100	0	0
United Kingdom	23	0	44	9	0	25	0	0
United States	24	0	47	12	0	17	0	1
Uzbekistan	0	0	0	100	0	0	0	0
Venezuela	3	0	86	9	0	3	0	0

Tab. 11.4: Share of various fuels in the total final energy consumption in the non-metallic minerals sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

11.3 Energy Intensity in the Non-metallic Minerals Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the non-metallic minerals sector (in toe) and value added in the non-metallic minerals sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the non-metallic minerals sector only.

Energy intensity (energy consumption per value added) in the non-metallic minerals sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Thailand	1649	38	1	-23
Bulgaria	1447	-8	-9	1
Greece	1079	-12	-2	12
Slovak Republic	970	-5	0	6
Latvia	881	39	37	14
Norway	863	1	1	0
Sweden	713	2	-1	0
Portugal	687	-1	8	10
Italy	609	-3	3	8
Philippines	604	19	1	-14
France	591	3	3	1
Finland	555	-12	-6	7
Spain	529	-5	5	12
Hungary	526	-10	-2	9
South Africa	526	0	-4	-2
Mexico	492	-1	0	3
Czech Republic	483	4	-1	-4
Brazil	472	1	7	11
Belgium	441	-1	-4	-2
Romania	423	-4	-4	0
Netherlands	415	-4	-1	8
Oman	413	30	32	1
Korea, Rep.	404	-3	-1	3
Japan	395	0	-2	-2
United Kingdom	374	-1	-2	-1
Ireland	359	0	5	5
United States	356	15	22	6
Austria	305	0	-1	0
Jordan	72	-3	-6	-3
Bangladesh	14	-51	185	-8
Peru	2	-12	0	12

Tab. 11.5: Energy intensity (energy consumption per value added) in the non-metallic minerals sector

12. Energy Intensity Indicators for the Iron and Steel Sector

The iron and steel sector is here defined as the sum of the following ISIC divisions (Rev. 3):

271 Manufacture of basic iron and steel

2731 Casting of iron and steel

The following countries were analyzed for energy intensity in the iron and steel sector (chapter 12.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
Egypt South Africa	Japan Korea, Rep. Singapore			Austria Belgium Finland France Hungary Italy Norway Portugal Slovak Rep. Spain Sweden UK	Iran Jordan	Canada Mexico United States	Peru

Tab. 12.1: Analyzed countries for energy intensity in the iron and steel sector

12.1 Energy Consumption in the Iron and Steel Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Algeria	622	621	496	358	412	464	-4
Argentina	168	151	224	129	147	147	2
Australia	2484	2445	2434	2401	2464	2393	-1
Austria	1221	1241	1263	1559	1498	1337	2
Azerbaijan	158	3	3	4	4	2	-23
Belarus	118	107	129	166	192	197	12
Belgium	3095	2765	2837	3057	3212	3190	1
Bosnia and Herzegovina	15	15	16	16	17	18	4
Brazil	11241	10906	10983	11156	10746	10954	0
Bulgaria	942	1051	953	1015	864	715	-5
Canada	4480	4579	4622	4562	4677	4763	1
Chile	417	431	482	344	352	340	-3
China	63908	66197	67721	67814	69822	67845	1
Chinese Taipei	3099	3178	3337	3747	4935	4834	10
Colombia	447	682	720	729	730	626	9
Congo (Dem. Rep.)	36	52	37	37	37	37	3
Croatia	135	89	76	84	65	40	-20
Cuba	60	60	26	26	28	25	-12
Czech Republic	3404	2708	2600	2473	2463	2345	-7
Denmark	105	109	105	100	101	103	0
Egypt	588	519	547	549	549	549	-1
Finland	1041	1051	992	1137	1162	1199	3
Former USSR	44225	46825	43310	39821	37787	39459	-2
France	4819	5340	5323	5438	5498	5099	1
Georgia	305	96	103	84	52	52	-24
Germany	8320	8340	9150	9405	9824	9429	3
Greece	171	137	99	114	151	172	3
Hungary	935	939	916	593	559	571	-8
Iceland	107	105	115	104	107	103	-1
India	14733	13979	14447	16762	15771	14988	1
Indonesia	1665	1775	1853	1922	1927	2045	4
Iran	412	431	411	411	460	513	5
Ireland	50	49	46	49	51	55	2
Israel	70	76	84	82	83	84	4
Italy	5299	5441	4935	5211	4875	4707	-2
Japan	21720	21798	21694	22502	23111	22178	0
Kazakhstan	806	1262	1110	1269	1218	1490	15
Korea	3741	3857	4086	3900	3680	4330	3
Korea, DPR	1293	1276	1257	1240	1178	1190	-2

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Latvia	100	67	93	167	130	129	12
Lithuania	6	5	5	7	6	6	2
Luxembourg	711	501	490	430	327	351	-12
Macedonia	189	187	201	196	290	194	4
Mexico	4818	5439	5745	6060	5806	5642	3
Netherlands	1591	1611	1680	1834	1790	1713	2
New Zealand	795	839	811	318	342	353	-10
Nigeria	61	56	56	59	63	67	2
Norway	1123	1206	1178	1149	1284	1278	3
Pakistan	259	259	257	199	227	217	-3
Peru	66	222	226	603	1018	1060	96
Philippines	310	348	371	403	429	416	6
Poland	4095	4354	4155	4436	3685	3161	-5
Portugal	177	191	210	190	196	194	2
Qatar	426	420	478	506	524	539	5
Romania	3025	3400	3178	3074	2952	2339	-4
Russia	34796	38570	35333	31577	29769	30778	-2
Singapore	65	69	74	84	84	87	6
Slovak Republic	932	1631	1741	1720	1507	1573	15
Slovenia	185	178	167	149	154	146	-5
South Africa	5378	5680	5005	4406	5888	5708	2
Spain	2955	3020	2771	3081	3044	3078	1
Sweden	1194	1253	1267	1205	1111	1076	-2
Switzerland						146	
Thailand	562	565	696	674	500	542	1
Trinidad and Tobago	315	360	367	418	410	492	10
Tunisia	48	51	51	51	44	59	5
Turkey	1824	2337	2133	2043	2013	1937	2
Ukraine	7931	6660	6479	6546	6416	6804	-3
United Kingdom	4649	4559	4572	4319	3811	3954	-3
United States	12913	24991	24880	26729	27070	26051	20
Venezuela	3311	3417	3667	3312	3479	3016	-1
Yugoslavia (Fed. Rep.)	28	29	29	31	30	28	0
Zambia	11	11	11	11	11	11	0
Zimbabwe	270	293	300	250	302	296	3

Tab. 12.2: Energy consumption in the iron and steel sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the iron and steel sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Peru	66	222	226	603	1018	1060	96
United States	12913	24991	24880	26729	27070	26051	20
Kazakhstan	806	1262	1110	1269	1218	1490	15
Slovak Republic	932	1631	1741	1720	1507	1573	15
Latvia	100	67	93	167	130	129	12
Belarus	118	107	129	166	192	197	12
Chinese Taipei	3099	3178	3337	3747	4935	4834	10
Trinidad and Tobago	315	360	367	418	410	492	10
Colombia	447	682	720	729	730	626	9
Philippines	310	348	371	403	429	416	6
Singapore	65	69	74	84	84	87	6
Tunisia	48	51	51	51	44	59	5
Qatar	426	420	478	506	524	539	5
Iran	412	431	411	411	460	513	5
Indonesia	1665	1775	1853	1922	1927	2045	4
Israel	70	76	84	82	83	84	4
Bosnia and Herzegovina	15	15	16	16	17	18	4
Macedonia	189	187	201	196	290	194	4
Mexico	4818	5439	5745	6060	5806	5642	3
Korea	3741	3857	4086	3900	3680	4330	3
Congo (Dem. Rep.)	36	52	37	37	37	37	3
Finland	1041	1051	992	1137	1162	1199	3
Greece	171	137	99	114	151	172	3
Norway	1123	1206	1178	1149	1284	1278	3
Germany	8320	8340	9150	9405	9824	9429	3
Zimbabwe	270	293	300	250	302	296	3
South Africa	5378	5680	5005	4406	5888	5708	2
Austria	1221	1241	1263	1559	1498	1337	2
Portugal	177	191	210	190	196	194	2
Ireland	50	49	46	49	51	55	2
Nigeria	61	56	56	59	63	67	2
Turkey	1824	2337	2133	2043	2013	1937	2
Argentina	168	151	224	129	147	147	2
Lithuania	6	5	5	7	6	6	2
Netherlands	1591	1611	1680	1834	1790	1713	2
France	4819	5340	5323	5438	5498	5099	1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Canada	4480	4579	4622	4562	4677	4763	1
China	63908	66197	67721	67814	69822	67845	1
Spain	2955	3020	2771	3081	3044	3078	1
Belgium	3095	2765	2837	3057	3212	3190	1
India	14733	13979	14447	16762	15771	14988	1
Thailand	562	565	696	674	500	542	1
Japan	21720	21798	21694	22502	23111	22178	0
Yugoslavia (Fed. Rep.)	28	29	29	31	30	28	0
Zambia	11	11	11	11	11	11	0
Denmark	105	109	105	100	101	103	0
Brazil	11241	10906	10983	11156	10746	10954	0
Iceland	107	105	115	104	107	103	-1
Australia	2484	2445	2434	2401	2464	2393	-1
Egypt	588	519	547	549	549	549	-1
Venezuela	3311	3417	3667	3312	3479	3016	-1
Korea, DPR	1293	1276	1257	1240	1178	1190	-2
Sweden	1194	1253	1267	1205	1111	1076	-2
Former USSR	44225	46825	43310	39821	37787	39459	-2
Russia	34796	38570	35333	31577	29769	30778	-2
Italy	5299	5441	4935	5211	4875	4707	-2
Ukraine	7931	6660	6479	6546	6416	6804	-3
Pakistan	259	259	257	199	227	217	-3
Chile	417	431	482	344	352	340	-3
United Kingdom	4649	4559	4572	4319	3811	3954	-3
Algeria	622	621	496	358	412	464	-4
Romania	3025	3400	3178	3074	2952	2339	-4
Slovenia	185	178	167	149	154	146	-5
Poland	4095	4354	4155	4436	3685	3161	-5
Bulgaria	942	1051	953	1015	864	715	-5
Czech Republic	3404	2708	2600	2473	2463	2345	-7
Hungary	935	939	916	593	559	571	-8
New Zealand	795	839	811	318	342	353	-10
Cuba	60	60	26	26	28	25	-12
Luxembourg	711	501	490	430	327	351	-12
Croatia	135	89	76	84	65	40	-20
Azerbaijan	158	3	3	4	4	2	-23
Georgia	305	96	103	84	52	52	-24

Tab. 12.3: Country ranking according to the average annual change in energy consumption in the iron and steel sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

12.2 Energy Consumption in the Iron and Steel Sector by Fuel

Country	Coal	Coke Oven Coke and Lignite Coke	Coke Oven Gas	Blast Furnace Gas	Combustible Renewables and Waste	Natural Gas	Oil	Electricity	Heat	Other
	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Algeria	0	23	0	13	0	50	0	14	0	0
Argentina	0	34	66	0	0	0	0	0	0	0
Australia	2	3	23	29	0	19	0	21	0	1
Austria	0	20	9	17	0	27	12	14	0	1
Azerbaijan	0	0	0	0	0	0	0	100	0	0
Belarus	0	4	0	0	0	39	4	54	0	0
Belgium	11	32	6	13	0	20	1	17	0	0
Brazil	14	10	7	7	36	6	2	15	0	3
Bulgaria	2	3	7	30	0	37	3	17	1	0
Canada	0	14	12	12	0	39	4	19	0	0
Chile	15	21	5	34	0	1	16	8	0	0
China	28	18	10	20	0	0	5	13	4	2
Chinese Taipei	12	21	15	13	0	3	15	20	0	1
Colombia	50	6	0	2	0	4	4	25	0	9
Congo (Dem. Rep.)	0	38	0	62	0	0	0	0	0	0
Croatia	0	10	0	0	0	45	8	33	0	5
Cuba	40	12	0	12	0	0	0	36	0	0
Czech Republic	33	14	9	11	0	10	8	11	5	0
Denmark	0	1	0	0	0	42	2	50	2	3
Egypt	0	35	0	56	0	0	0	0	0	9
Finland	2	16	13	22	0	15	12	18	0	2
Former USSR	0	11	2	21	0	28	3	18	15	2
France	18	13	9	15	0	17	1	26	0	1
Georgia	0	0	0	0	0	52	0	48	0	0
Germany	17	11	8	18	0	26	1	20	0	0
Greece	0	0	0	0	0	28	17	41	0	13
Hungary	0	37	10	11	0	21	7	8	5	0
Iceland	26	17	0	0	0	0	0	56	0	1
India	50	11	0	17	0	0	5	17	0	0
Indonesia	6	0	0	0	0	35	59	0	0	0
Iran	0	39	0	62	0	0	0	0	0	0
Ireland	0	0	0	0	0	38	5	49	0	7
Israel	0	0	0	0	0	0	0	100	0	0
Italy	1	23	4	3	0	34	2	34	0	0
Japan	1	16	13	18	0	7	7	31	0	8
Jordan	0	0	0	0	0	0	0	100	0	0
Kazakhstan	0	17	0	0	0	0	21	17	0	45
Korea (Rep.)	0	0	0	0	0	9	20	67	0	4
Korea, DPR	0	38	0	62	0	0	0	0	0	0

Country	Coal	Coke Oven Coke and Lignite Coke	Coke Oven Gas	Blast Furnace Gas	Combustible Renewables and Waste	Natural Gas	Oil	Electricity	Heat	Other
	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Latvia	0	1	0	0	0	71	0	7	0	21
Lithuania	0	17	0	0	0	0	0	83	0	0
Luxembourg	8	0	0	0	0	40	6	45	0	0
Macedonia	43	0	0	0	0	0	13	36	4	4
Mexico	0	31	0	0	0	43	11	14	0	0
Netherlands	47	0	10	13	0	18	0	11	0	0
New Zealand	97	0	0	0	0	0	0	3	0	0
Nigeria	0	0	0	0	0	100	0	0	0	0
Norway	25	21	0	1	0	0	1	52	0	0
Pakistan	0	38	0	62	0	0	0	0	0	0
Peru	4	3	0	3	0	0	54	34	0	3
Philippines	2	6	0	10	0	0	60	21	0	1
Poland	14	16	12	18	0	16	2	18	4	0
Portugal	0	25	6	5	0	10	11	35	0	8
Qatar	0	0	0	0	0	69	0	31	0	0
Romania	0	6	6	12	0	40	8	27	1	0
Russia	1	6	3	17	0	35	3	16	19	0
Singapore	0	0	0	0	0	0	0	100	0	0
Slovak Republic	24	13	12	15	0	16	2	17	0	0
Slovenia	0	10	0	0	0	43	0	46	0	1
South Africa	49	4	4	7	0	0	3	29	0	3
Spain	4	18	2	5	0	22	6	37	0	6
Sweden	1	9	8	10	0	2	14	40	0	17
Switzerland	0	0	0	0	0	36	12	52	0	0
Syria	0	0	0	100	0	0	0	0	0	0
Thailand	0	2	0	3	0	0	35	54	0	6
Trinidad and Tobago	0	0	0	0	0	100	0	0	0	0
Tunisia	0	27	0	44	0	0	0	29	0	0
Turkey	0	6	13	14	0	12	22	34	0	0
Ukraine	0	28	0	45	0	0	0	27	0	0
United Kingdom	0	18	9	7	0	43	2	22	0	1
United States	7	10	0	14	0	44	1	23	1	0
Venezuela	0	0	0	0	0	84	0	16	0	0
Yugoslavia (Fed. Rep.)	0	0	0	0	0	0	0	100	0	0
Zambia	0	36	0	64	0	0	0	0	0	0
Zimbabwe	42	15	18	25	0	0	0	0	0	0

Tab. 12.4: Share of various fuels in the total final energy consumption in the iron and steel sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

12.3 Energy Intensity in the Iron and Steel Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the iron and steel sector (in toe) and value added in the iron and steel sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the iron and steel sector only.

Energy intensity (energy consumption per value added) in the iron and steel sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Norway	5474	7	3	-3
Slovak Republic	2667	15	15	0
Finland	1575	16	3	-10
Belgium	1435	9	1	-7
South Africa	1329	0	2	3
France	1232	3	1	-1
Mexico	1201	-2	3	7
United Kingdom	1164	6	-3	-7
Hungary	1110	-16	-8	17
Japan	992	3	0	-2
Singapore	948	9	6	-2
Peru	915	-8	96	251
Spain	858	-4	1	11
Austria	837	3	2	16
Canada	832	-3	1	5
United States	716	27	20	-6
Sweden	715	2	-2	2
Italy	604	-6	-2	7
Portugal	562	-2	2	5
Egypt	535	-24	-1	34
Korea, Rep.	257	-3	3	6
Iran	43	-4	5	22
Jordan	11	-8		9

Tab. 12.5: Energy intensity (energy consumption per value added) in the iron and steel sector

13. Energy Intensity Indicators for the Non-ferrous Metals Sector

The non-ferrous metals sector is here defined as the sum of the following ISIC divisions (Rev. 3):

272 Manufacture of basic precious and non-ferrous metals

2732 Casting of non-ferrous metals

The following countries were analyzed for energy intensity in the non-ferrous metals sector (chapter 13.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
South Africa	Japan Korea, Rep.			Austria Belgium Finland France Italy Latvia Norway Portugal Spain Sweden UK	Oman	Canada Mexico United States	

Tab. 13.1: Analyzed countries for energy intensity in the non-ferrous metals sector

13.1 Energy Consumption in the Non-ferrous Metals Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Armenia		2	1	1	2	2	13
Australia	6858	6807	6861	7146	7429	7694	2
Austria	53	99	100	68	107	107	23
Azerbaijan	34	22	12	11	14	86	90
Bahrain	551	602	733	665	640	519	0
Belarus	1	1	1	1	1	1	0
Belgium	337	366	340	341	302	309	-1
Brazil	3652	3871	4031	3825	3926	4200	3
Bulgaria	303	323	215	191	191	173	-9
Canada	5169	5106	5385	5346	5561	5526	1
Chile	688	770	887	1061	1235	1420	16
China	11385	11572	12704	12327	13488	13183	3
Chinese Taipei	106	119	138	160	178	179	11
Croatia	8	10	10	13	14	14	13
Czech Republic	30	43	80	73	70	177	54
Denmark	30	30	11	13	14	13	-9
Finland	175	178	183	186	198	208	4
Former USSR	17515	17072	17148	16730	16642	18868	2
France	1537	1354	1377	1382	1429	1474	-1
Germany	2744	2538	2545	2571	2636	2629	-1
Greece	606	611	672	653	647	699	3
Hungary	175	167	188	230	263	217	5
Iceland	140	145	150	182	246	307	18
India	140	151	179	2159	2285	2427	229
Ireland	313	279	267	271	271	283	-2
Italy	793	823	840	892	901	953	4
Japan	3801	3594	3480	3450	3268	3368	-2
Kazakhstan	632	618	553	495	253	592	12
Korea	169	210	170	154	147	196	5
Kyrgyzstan	27	25	26	22	18	13	-13
Macedonia	99	96	99	91	88	81	-4
Mexico	107	96	109	139	127	122	4
Netherlands	490	496	503	523	565	574	3
New Zealand				423	426	429	1
Norway	1540	1547	1425	1530	1683	1703	2
Oman	14	13	14	17	16	16	3
Poland	683	738	739	754	764	745	2
Portugal	33	34	32	33	36	33	0
Russia	16039	15659	15829	15569	15720	17505	2
Slovenia	144	125	110	129	115	135	0

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
South Africa	530	616	1143	1281	1291	1323	23
Spain	991	947	984	1028	1110	1094	2
Sweden	270	302	305	306	307	304	3
Switzerland	101	101	99	108	112	154	10
Tajikistan	464	442	434	340	357	400	-2
Turkey	511	537	657	652	658	718	7
Ukraine	317	302	293	292	276	267	-3
United Kingdom	1047	982	1054	1127	1126	1225	3
United States	7823	15189	14522	15126	14939	14873	18
Venezuela	1401	1461	1689	1602	1558	1465	1
Zambia	409	412	414	424	417	427	1

Tab. 13.2: Energy consumption in the non-ferrous metals sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the non-ferrous metals sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
India	140	151	179	2159	2285	2427	229
Azerbaijan	34	22	12	11	14	86	90
Czech Republic	30	43	80	73	70	177	54
South Africa	530	616	1143	1281	1291	1323	23
Austria	53	99	100	68	107	107	23
United States	7823	15189	14522	15126	14939	14873	18
Iceland	140	145	150	182	246	307	18
Chile	688	770	887	1061	1235	1420	16
Croatia	8	10	10	13	14	14	13
Armenia		2	1	1	2	2	13
Kazakhstan	632	618	553	495	253	592	12
Chinese Taipei	106	119	138	160	178	179	11
Switzerland	101	101	99	108	112	154	10
Turkey	511	537	657	652	658	718	7
Hungary	175	167	188	230	263	217	5
Korea	169	210	170	154	147	196	5
Italy	793	823	840	892	901	953	4
Mexico	107	96	109	139	127	122	4
Finland	175	178	183	186	198	208	4
United Kingdom	1047	982	1054	1127	1126	1225	3
Netherlands	490	496	503	523	565	574	3
Oman	14	13	14	17	16	16	3
China	11385	11572	12704	12327	13488	13183	3
Greece	606	611	672	653	647	699	3
Brazil	3652	3871	4031	3825	3926	4200	3
Sweden	270	302	305	306	307	304	3
Australia	6858	6807	6861	7146	7429	7694	2
Norway	1540	1547	1425	1530	1683	1703	2
Spain	991	947	984	1028	1110	1094	2
Russia	16039	15659	15829	15569	15720	17505	2
Poland	683	738	739	754	764	745	2
Former USSR	17515	17072	17148	16730	16642	18868	2
Canada	5169	5106	5385	5346	5561	5526	1
Venezuela	1401	1461	1689	1602	1558	1465	1
Zambia	409	412	414	424	417	427	1
New Zealand				423	426	429	1
Portugal	33	34	32	33	36	33	0

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Belarus	1	1	1	1	1	1	0
Bahrain	551	602	733	665	640	519	0
Slovenia	144	125	110	129	115	135	0
France	1537	1354	1377	1382	1429	1474	-1
Germany	2744	2538	2545	2571	2636	2629	-1
Belgium	337	366	340	341	302	309	-1
Ireland	313	279	267	271	271	283	-2
Tajikistan	464	442	434	340	357	400	-2
Japan	3801	3594	3480	3450	3268	3368	-2
Ukraine	317	302	293	292	276	267	-3
Macedonia	99	96	99	91	88	81	-4
Denmark	30	30	11	13	14	13	-9
Bulgaria	303	323	215	191	191	173	-9
Kyrgyzstan	27	25	26	22	18	13	-13

Tab. 13.3: Country ranking according to the average annual change in energy consumption in the non-ferrous metals sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

13.2 Energy Consumption in the Non-ferrous Metals Sector by Fuel

Country	Coal [%]	Coke Oven Coke and Lignite Coke [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Liquefied Petroleum Gases [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Armenia	0	0	0	0	0	0	100	0	0
Australia	16	2	1	33	0	9	39	0	0
Austria	0	5	0	49	7	10	30	0	0
Azerbaijan	0	0	0	84	0	0	16	0	0
Bahrain	0	0	0	100	0	0	0	0	0
Belarus	0	0	0	0	0	0	100	0	0
Belgium	0	6	0	33	0	7	53	0	0
Brazil	3	2	1	1	2	25	58	0	9
Bulgaria	0	30	0	4	1	29	36	1	0
Canada	5	1	0	13	0	3	79	0	0
Chile	0	0	0	3	0	31	66	0	0
China	31	10	0	0	0	7	40	10	1
Chinese Taipei	0	0	0	0	6	51	41	0	1
Croatia	0	0	0	21	14	14	43	0	7
Czech Republic	0	0	0	28	0	1	13	58	1
Denmark	0	0	0	23	0	15	54	0	8
Finland	0	4	0	0	0	12	84	0	0
Former USSR	3	3	0	11	0	12	48	23	0
France	0	0	0	24	15	5	55	0	1
Germany	0	3	0	30	1	4	59	0	1
Greece	15	0	0	4	5	32	43	0	0
Hungary	0	0	0	43	0	0	33	23	0
Iceland	0	0	0	0	0	2	98	0	0
India	0	0	0	0	0	6	94	0	0
Ireland	0	0	0	0	0	89	10	0	0
Italy	0	6	0	38	3	7	47	0	0
Japan	3	6	0	8	7	20	49	0	6
Kazakhstan	0	0	0	0	0	57	43	0	0
Korea	0	0	0	0	18	53	19	0	10
Kyrgyzstan	0	0	0	0	0	0	100	0	0
Latvia	0	0	0	100	0	0	0	0	0
Macedonia	52	0	0	0	1	20	19	9	0
Mexico	0	0	0	77	0	0	23	0	0
Netherlands	0	0	0	15	0	0	85	0	0
New Zealand	0	0	0	0	0	0	100	0	0
Norway	0	1	0	0	1	3	95	0	0
Oman	0	0	0	0	0	0	100	0	0
Poland	10	19	7	18	0	2	43	2	0
Portugal	0	0	15	3	18	36	30	0	0
Russia	3	4	0	11	0	11	47	24	0
Slovenia	1	0	0	9	1	3	74	0	13

Country	Coal [%]	Coke Oven Coke and Lignite Coke [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Liquefied Petroleum Gases [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
South Africa	0	0	0	0	0	0	97	0	3
Spain	0	4	0	12	1	12	71	0	0
Sweden	12	1	0	2	5	5	75	0	0
Switzerland	0	0	1	21	0	5	73	0	1
Tajikistan	0	0	0	0	0	0	100	0	0
Turkey	2	1	0	24	0	40	32	0	0
Ukraine	0	0	0	0	0	0	100	0	0
United Kingdom	13	8	0	35	0	3	41	0	0
United States	0	0	0	43	0	8	48	0	0
Venezuela	0	0	0	35	0	0	58	0	7
Zambia	0	0	0	0	0	17	83	0	0

Tab. 13.4: Share of various fuels in the total final energy consumption in the non-ferrous metals sector in 1999.

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001).

13.3 Energy Intensity in the Non-ferrous Metals Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the non-ferrous metals sector (in toe) and value added in the non-ferrous metals sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the non-ferrous metals sector only.

Energy intensity (energy consumption per value added) in non-ferrous metals sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Norway	2871	4	2	0
Canada	1139	-3	1	6
Latvia	941			43
Sweden	808	0	3	5
France	716	-4	-1	4
Spain	710	-8	2	17
Finland	617	3	4	9
United Kingdom	604	11	3	-5
South Africa	593	12	23	10
Japan	578	3	-2	-3
United States	558	17	18	1
Oman	361	24	3	-9
Belgium	358	2	-1	-2
Italy	297	-5	4	11
Portugal	245	4	0	-4
Austria	184	21	23	3
Mexico	69	3	4	3
Korea, Rep.	55	0	5	10

Tab. 13.5: Energy intensity (energy consumption per value added) in the non-ferrous metals sector

14. Energy Intensity Indicators for the Machinery Sector

The machinery sector is here defined as the sum of the following ISIC divisions (Rev. 3):

28 Manufacture of fabricated metal product, except machinery and equipment

- 281 Manufacture of structural metal products, tanks, reservoirs and steam generators
- 289 Manufacture of other fabricated metal products; metal working service activities

29 Manufacture of machinery and equipment n.e.c.

- 291 Manufacture of general purpose machinery
- 292 Manufacture of special purpose machinery
- 293 Manufacture of domestic appliances n.e.c.

30 Manufacture of office machinery and computers

31 Manufacture of electrical machinery and apparatus n.e.c.

- 311 Manufacture of electric motors, generators and transformers
- 312 Manufacture of electricity distribution and control apparatus
- 313 Manufacture of insulated wire and cable
- 314 Manufacture of accumulators, primary cells and primary batteries
- 315 Manufacture of electric lamps and lighting equipment
- 319 Manufacture of other electrical equipment n.e.c.

32 Manufacture of radio, television and communication equipment and apparatus

- 321 Manufacture of electronic valves and tubes and other electronic components
- 322 Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
- 323 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

The following countries were analyzed for energy intensity in the machinery sector (chapter 14.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
South Africa	Japan Korea, Rep.			Austria Belgium Bulgaria Czech Rep. France Greece Italy Latvia Norway Portugal Spain Sweden UK		United States	

Tab. 14.1: Analyzed countries for energy intensity in the machinery sector

14.1 Energy Consumption in the Machinery Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Armenia		11	12	9	5	4	-20
Australia	436	340	318	323	328	340	-4
Austria	158	220	228	301	321	378	20
Azerbaijan	88	20	10	8	1	13	193
Belarus	838	575	690	814	780	766	0
Belgium	318	303	289	268	274	264	-4
Bulgaria	315	301	279	233	210	145	-14
China	23669	22315	23722	20380	19977	17679	-5
Chinese Taipei	895	1006	1115	1296	1308	1584	12
Colombia	168	252	203	262	234	167	4
Croatia	62	38	28	47	44	42	-2
Cyprus	2	2	2	2	2	2	0
Czech Republic	654	742	658	606	508	620	0
Denmark	244	234	362	326	325	339	9
Estonia	36	29	25	22	24	21	-10
Finland	264	267	232	227	263	276	1
Former USSR	27652	25164	20784	19362	17766	17254	-9
France	2862	3029	3235	3126	3266	3347	3
Germany	3002	3381	3510	3349	3240	3176	1
Greece	39	43	56	60	61	63	11
Hungary	233	212	222	236	210	194	-3
India	476	554	602	595	642	685	8
Indonesia	68	69	69	71	61	67	0
Ireland	117	124	120	126	132	137	3
Israel	8	9	60	60	69	75	121
Italy	3566	3636	3790	4085	4297	4427	4
Japan	7003	7124	7117	7372	7272	7398	1
Kazakhstan	135	110	98	88	157	178	10
Korea	1940	2173	2470	2654	2541	2911	9
Kyrgyzstan	22	20	17	14	13	11	-13
Latvia	27	22	40	39	36	31	8
Lithuania	96	86	80	86	65	57	-9
Luxembourg	41	44	44	47	50	59	8
Macedonia	8	8	12	10	14	12	12
Mexico	41	16	33	37	40	43	15
Moldova	18	22	22	18	20	15	-2
Morocco	21	21	22	23	24	26	4
Netherlands	694	785	795	784	789	858	4
New Zealand	35	36	35	12	12	13	-11
Norway	165	179	155	162	155	142	-3

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Philippines	69	75	75	100	104	107	10
Poland	1505	1467	1545	1443	1219	966	-8
Portugal	91	102	102	87	95	100	2
Romania	1670	1330	1644	1465	1105	921	-10
Russia	25452	23507	19140	17739	16156	15693	-9
Slovak Republic		273	311	296	283	271	0
Slovenia	140	114	96	100	112	109	-4
South Africa	115	118	128	141	30	33	-9
Spain	848	693	743	886	1006	926	3
Sweden	613	554	559	324	312	293	-12
Switzerland	463	434	451	419	460	446	-1
Tajikistan	80	81	79	2	2	2	-20
Thailand	481	628	688	640	570	713	9
Turkey	141	151	181	207	200	204	8
Ukraine	860	681	569	520	501	457	-12
United Kingdom	2939	2983	3139	2820	2800	2815	-1
United States	9918	21349	21751	22486	22154	22126	24
Uzbekistan			2	4	4	4	33

Tab. 14.2: Energy consumption in the machinery sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the machinery sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Azerbaijan	88	20	10	8	1	13	193
Israel	8	9	60	60	69	75	121
Uzbekistan			2	4	4	4	33
United States	9918	21349	21751	22486	22154	22126	24
Austria	158	220	228	301	321	378	20
Mexico	41	16	33	37	40	43	15
Chinese Taipei	895	1006	1115	1296	1308	1584	12
Macedonia	8	8	12	10	14	12	12
Greece	39	43	56	60	61	63	11
Kazakhstan	135	110	98	88	157	178	10
Philippines	69	75	75	100	104	107	10
Thailand	481	628	688	640	570	713	9
Denmark	244	234	362	326	325	339	9
Korea	1940	2173	2470	2654	2541	2911	9
Turkey	141	151	181	207	200	204	8
Latvia	27	22	40	39	36	31	8
Luxembourg	41	44	44	47	50	59	8
India	476	554	602	595	642	685	8
Netherlands	694	785	795	784	789	858	4
Italy	3566	3636	3790	4085	4297	4427	4
Morocco	21	21	22	23	24	26	4
Colombia	168	252	203	262	234	167	4
Ireland	117	124	120	126	132	137	3
France	2862	3029	3235	3126	3266	3347	3
Spain	848	693	743	886	1006	926	3
Portugal	91	102	102	87	95	100	2
Finland	264	267	232	227	263	276	1
Germany	3002	3381	3510	3349	3240	3176	1
Japan	7003	7124	7117	7372	7272	7398	1
Belarus	838	575	690	814	780	766	0
Slovak Republic		273	311	296	283	271	0
Indonesia	68	69	69	71	61	67	0
Czech Republic	654	742	658	606	508	620	0
Cyprus	2	2	2	2	2	2	0
Switzerland	463	434	451	419	460	446	-1
United Kingdom	2939	2983	3139	2820	2800	2815	-1
Croatia	62	38	28	47	44	42	-2

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Moldova	18	22	22	18	20	15	-2
Norway	165	179	155	162	155	142	-3
Hungary	233	212	222	236	210	194	-3
Belgium	318	303	289	268	274	264	-4
Slovenia	140	114	96	100	112	109	-4
Australia	436	340	318	323	328	340	-4
China	23669	22315	23722	20380	19977	17679	-5
Poland	1505	1467	1545	1443	1219	966	-8
Former USSR	27652	25164	20784	19362	17766	17254	-9
Russia	25452	23507	19140	17739	16156	15693	-9
Lithuania	96	86	80	86	65	57	-9
South Africa	115	118	128	141	30	33	-9
Estonia	36	29	25	22	24	21	-10
Romania	1670	1330	1644	1465	1105	921	-10
New Zealand	35	36	35	12	12	13	-11
Ukraine	860	681	569	520	501	457	-12
Sweden	613	554	559	324	312	293	-12
Kyrgyzstan	22	20	17	14	13	11	-13
Bulgaria	315	301	279	233	210	145	-14
Tajikistan	80	81	79	2	2	2	-20
Armenia		11	12	9	5	4	-20

Tab. 14.3: Country ranking according to the average annual change in energy consumption in the machinery sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

14.2 Energy Consumption in the Machinery Sector by Fuel

Country	Coal [%]	Coke Oven Coke and Lignite Coke [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Liquefied Petroleum Gases [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Armenia	0	0	0	0	0	0	100	0	0
Australia	0	0	0	44	10	1	46	0	0
Austria	0	0	0	37	5	11	45	2	0
Azerbaijan	0	0	0	62	0	0	38	0	0
Belarus	0	4	0	16	0	3	28	47	0
Belgium	0	3	0	19	0	14	64	0	0
Bulgaria	1	1	1	24	1	26	43	3	0
China	36	15	0	3	1	11	27	4	2
Chinese Taipei	0	0	0	7	0	2	91	0	0
Colombia	0	0	0	2	1	44	23	0	30
Croatia	0	0	0	29	2	12	33	24	0
Cyprus	0	0	0	0	0	0	100	0	0
Czech Republic	8	3	0	26	0	5	30	27	1
Denmark	0	0	1	27	3	17	43	8	0
Estonia	0	5	5	10	0	5	52	24	0
Finland	0	0	1	0	0	18	80	0	0
Former USSR	0	1	0	11	0	3	26	58	0
France	1	4	0	48	0	5	43	0	0
Germany	0	1	0	50	2	18	26	0	2
Greece	0	2	0	0	0	19	79	0	0
Hungary	3	3	0	62	1	4	24	5	0
India	0	0	0	0	0	100	0	0	0
Indonesia	0	0	0	0	0	100	0	0	0
Ireland	0	0	0	0	4	36	55	0	5
Israel	0	0	0	0	0	0	100	0	0
Italy	0	0	0	45	2	14	37	0	1
Japan	1	0	0	19	7	3	61	0	9
Kazakhstan	0	0	0	0	0	11	89	0	0
Korea	0	0	0	0	3	24	73	0	1
Kyrgyzstan	0	0	0	0	0	0	100	0	0
Latvia	0	0	35	10	0	13	35	6	0
Lithuania	0	2	5	33	0	5	44	12	0
Luxembourg	0	0	0	0	0	0	100	0	0
Macedonia	0	0	0	0	0	17	50	25	8
Mexico	0	0	0	0	84	16	0	0	0
Morocco	0	0	0	0	0	0	100	0	0
Netherlands	0	0	0	56	1	1	43	0	0
New Zealand	0	0	0	0	0	0	100	0	0
Norway	1	0	0	0	6	16	70	1	5
Philippines	0	0	0	0	1	21	78	0	1
Poland	31	2	0	18	1	4	31	13	1
Portugal	0	0	0	3	7	9	81	0	0
Romania	0	1	0	61	0	4	23	9	2

Country	Coal [%]	Coke Oven Coke and Lignite Coke [%]	Combustible Renewables and Waste [%]	Nat. gas [%]	Liquefied Petroleum Gases [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Russia	0	1	0	11	0	2	23	62	0
Slovak Republic	13	1	0	54	0	4	26	1	1
Slovenia	0	0	0	34	2	14	50	0	1
South Africa	0	0	0	0	0	39	12	0	48
Spain	0	2	0	23	3	11	50	0	11
Sweden	0	0	0	2	6	35	57	0	0
Switzerland	0	2	1	16	0	16	59	4	2
Tajikistan	0	0	0	0	0	0	100	0	0
Thailand	0	0	0	0	7	14	79	0	1
Turkey	5	0	0	7	0	0	87	0	0
Ukraine	0	0	0	0	0	0	100	0	0
United Kingdom	1	0	0	28	0	9	63	0	0
United States	1	0	0	45	1	5	47	0	0

Tab. 14.4: Share of various fuels in the total final energy consumption in the machinery sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

14.3 Energy Intensity in the Machinery Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the machinery sector (in toe) and value added in the machinery sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the machinery sector only.

Energy intensity (energy consumption per value added) in the machinery sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Latvia	129	7	8	3
Bulgaria	95	-14	-14	3
Czech Republic	76	5	0	-4
France	74	1	3	2
Norway	59	-5	-3	2
Italy	50	-7	4	16
United Kingdom	50	-3	-1	2
Greece	46	6	11	5
United States	43	23	24	1
Austria	36	18	20	2
Spain	35	-7	3	11
Japan	33	2	1	-1
Korea, Rep.	28	0	9	11
Belgium	27	-2	-4	-1
Sweden	24	-16	-12	11
Portugal	19	-3	2	5
South Africa	4	-8	-9	1

Tab. 14.5: Energy intensity (energy consumption per value added) in the machinery sector

15. Energy Intensity Indicators for the Transport Equipment Sector

The transport equipment sector is here defined as the sum of the following ISIC divisions (Rev. 3):

34 Manufacture of motor vehicles, trailers and semi-trailers

- 341 Manufacture of motor vehicles
- 342 Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
- 343 Manufacture of parts and accessories for motor vehicles and their engines

35 Manufacture of other transport equipment

- 351 Building and repairing of ships and boats
- 352 Manufacture of railway and tramway locomotives and rolling stock
- 353 Manufacture of aircraft and spacecraft
- 359 Manufacture of transport equipment n.e.c.

The following countries were analyzed for energy intensity in the transport equipment sector (chapter 15.3):

Africa	Asia	Australia	Central America & Caribbean	Europe	Middle East	North America	South America
	Japan Korea, Rep.			Austria Bulgaria Czech Rep. Finland France Greece Hungary Italy Latvia Norway Portugal Spain Sweden UK		United States	

Tab. 15.1: Analyzed countries for energy intensity in the transport equipment sector

15.1 Energy Consumption in the Transport Equipment Sector

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Australia	259	399	419	419	449	447	13
Austria	110	138	132	106	115	118	3
Azerbaijan				2		8	
Belarus	2	2	2	3	4	4	17
Belgium	182	195	207	196	189	194	1
Bulgaria			29	22	19	16	-18
China	5707	6187	6635	6108	6183	5357	-1
Chinese Taipei	136	143	144	151	153	153	2
Croatia	19	15	15	16	17	18	0
Czech Republic	269	248	212	190	179	193	-6
Denmark	48	46	60	62	61	61	6
Estonia	1	3	12	8	11	9	97
Finland	41	39	40	30	38	35	-2
Former USSR	184	141	146	124	137	163	-1
France	745	791	803	789	855	860	3
Georgia			2	2	2	2	0
Germany	2671	3015	3112	2993	2944	2924	2
Greece	16	27	31	25	36	38	23
Hungary	76	70	72	79	92	81	2
Iceland	1	1	1	1	1	1	0
India				462	492	522	6
Ireland	17	16	17	16	16	18	1
Israel	21	22	24	23	24	24	3
Italy	331	373	364	393	387	393	4
Japan	2468	2460	2575	2627	2537	2554	1
Kazakhstan					17	40	135
Korea	918	1074	1276	1633	1777	2182	19
Latvia	22	13	36	23	13	12	10
Lithuania	11	14	10	10	13	11	3
Macedonia	6	5	3	2	6	5	19
Mexico	127	110	143	159	173	189	9
Netherlands	141	139	142	131	133	131	-1
New Zealand				8	9	9	6
Norway	95	95	97	97	93	88	-1
Poland	673	620	676	604	547	463	-7
Portugal	42	42	50	71	73	79	14
Romania						199	7
Slovak Republic		113	124	116	113	101	-2
Slovenia			20	32	23	22	9
South Africa	7	4	5	5	4	9	17

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Spain	561	591	613	692	790	761	6
Sweden	212	275	321	303	293	285	7
Turkey	13	13	14	17	25	26	16
Ukraine	148	108	83	76	77	75	-12
United Kingdom	983	1034	1045	999	990	1054	1
United States	3318	7651	7769	8851	8716	8821	29

Tab. 15.2: Energy consumption in the transport equipment sector

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

Since a high average annual change in energy use is a good indicator for promising markets for the export of energy-efficiency technologies, the following table ranks the analyzed countries according their average annual growth rate in energy consumption in the transport equipment sector between 1994 and 1999:

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Kazakhstan					17	40	135
Estonia	1	3	12	8	11	9	97
United States	3318	7651	7769	8851	8716	8821	29
Greece	16	27	31	25	36	38	23
Korea	918	1074	1276	1633	1777	2182	19
Macedonia	6	5	3	2	6	5	19
South Africa	7	4	5	5	4	9	17
Belarus	2	2	2	3	4	4	17
Turkey	13	13	14	17	25	26	16
Portugal	42	42	50	71	73	79	14
Australia	259	399	419	419	449	447	13
Latvia	22	13	36	23	13	12	10
Slovenia			20	32	23	22	9
Mexico	127	110	143	159	173	189	9
Romania						199	7
Sweden	212	275	321	303	293	285	7
Spain	561	591	613	692	790	761	6
India				462	492	522	6
New Zealand				8	9	9	6
Denmark	48	46	60	62	61	61	6
Italy	331	373	364	393	387	393	4
France	745	791	803	789	855	860	3
Israel	21	22	24	23	24	24	3
Lithuania	11	14	10	10	13	11	3
Austria	110	138	132	106	115	118	3
Chinese Taipei	136	143	144	151	153	153	2
Germany	2671	3015	3112	2993	2944	2924	2
Hungary	76	70	72	79	92	81	2
United Kingdom	983	1034	1045	999	990	1054	1
Belgium	182	195	207	196	189	194	1
Ireland	17	16	17	16	16	18	1
Japan	2468	2460	2575	2627	2537	2554	1
Georgia			2	2	2	2	0
Iceland	1	1	1	1	1	1	0
Croatia	19	15	15	16	17	18	0
China	5707	6187	6635	6108	6183	5357	-1
Former USSR	184	141	146	124	137	163	-1

Country	Total final energy consumption [ktoe]						Average % change per year between 1994 and 1999
	1994	1995	1996	1997	1998	1999	
Netherlands	141	139	142	131	133	131	-1
Norway	95	95	97	97	93	88	-1
Finland	41	39	40	30	38	35	-2
Slovak Republic		113	124	116	113	101	-2
Czech Republic	269	248	212	190	179	193	-6
Poland	673	620	676	604	547	463	-7
Ukraine	148	108	83	76	77	75	-12
Bulgaria			29	22	19	16	-18

Tab. 15.3: Country ranking according to the average annual change in energy consumption in the transport equipment sector between 1994 and 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

15.2 Energy Consumption in the Transport Equipment Sector by Fuel

Country	Coal [%]	Nat. gas [%]	LPG [%]	Oil [%]	Electricity [%]	Heat [%]	Other [%]
Australia	0	38	4	0	58	0	0
Austria	0	37	1	6	44	12	0
Azerbaijan	0	100	0	0	0	0	0
Belarus	0	0	0	0	100	0	0
Belgium	0	54	0	0	46	0	0
Bulgaria	0	0	0	38	56	6	0
China	48	2	0	11	27	5	6
Chinese Taipei	0	5	7	5	84	0	0
Croatia	0	17	6	11	67	0	0
Czech Republic	14	24	0	3	38	19	1
Denmark	0	23	2	20	48	7	2
Finland	0	0	0	100	0	0	0
Former USSR	0	9	0	20	70	2	0
France	0	0	0	15	86	0	0
Georgia	0	0	0	0	100	0	0
Germany	0	33	3	4	54	6	1
Greece	0	3	5	53	37	0	3
Hungary	0	65	0	0	27	7	0
Iceland	0	0	0	0	100	0	0
India	0	0	0	0	100	0	0
Israel	0	0	0	0	100	0	0
Italy	0	0	0	0	100	0	0
Japan	0	0	0	0	100	0	0
Korea	0	23	1	41	33	0	2
Kyrgyzstan	0	0	0	0	100	0	0
Latvia	0	17	0	33	42	8	0
Macedonia	0	0	0	0	60	40	0
Mexico	0	41	0	0	59	0	0
Netherlands	0	53	0	5	42	0	0
New Zealand	0	0	0	0	100	0	0
Norway	0	0	7	10	82	1	0
Poland	31	12	0	6	28	19	3
Portugal	0	16	20	13	51	0	0
Romania	0	64	0	13	19	0	4
Slovak Republic	19	50	0	6	21	4	0
Slovenia	0	41	0	14	41	0	5
Spain	0	45	2	16	37	0	0
Sweden	0	4	7	16	69	0	4
Turkey	0	100	0	0	0	0	0
Ukraine	0	0	0	0	100	0	0
United Kingdom	6	78	0	13	0	0	4
United States	10	40	1	8	40	1	0

Tab. 15.4: Share of various fuels in the total final energy consumption in the transport equipment sector in 1999

Data source: International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

15.3 Energy Intensity in the Transport Equipment Sector (Energy Use per Value Added)

Energy intensity is here defined as the ratio between total final energy consumption in the transport equipment sector (in toe) and value added in the transport equipment sector (in constant 1995 US \$ using purchasing power parities).

Data sources:

For energy consumption and purchasing power parities:

International Energy Agency, Energy Balances of OECD and non-OECD countries (2001)

For value added:

United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database (2002)

Value added is expressed in constant 1995 US dollars using purchasing power parities:

The source of PPP data used in this work to convert the value added from the industry sector in all countries into constant 1995 US\$ is the International Energy Agency's Energy Balances database for OECD and non-OECD countries. The PPPs taken from this database are for the whole economy, i.e. GDP, and not for the transport equipment sector only.

Energy intensity (energy consumption per value added) in the transport equipment sector (countries ranked from highest to lowest energy intensity):

Country	Energy intensity in 1999 (Energy consumption [toe] per value added [mill 1995 US \$ PPP])	Average % change in energy intensity per year between 1994 and 1999	Average % change in energy consumption per year between 1994 and 1999	Average % change in value added per year between 1994 and 1999
Latvia	148	31	10	-9
Bulgaria	67	1	-18	-10
Czech Republic	63	-4	-6	-1
Greece	61	17	23	5
Spain	58	-3	6	11
Norway	56	-3	-1	1
Korea, Rep.	55	10	19	12
Austria	52	-3	3	6
Sweden	47	-1	7	11
Portugal	43	15	14	-1
United Kingdom	41	-2	1	3
United States	37	19	29	8
Hungary	36	-18	2	26
Finland	35	2	-2	-1
Japan	33	-3	1	4
France	33	-2	3	5
Italy	23	-3	4	8

Tab. 15.5: Energy intensity (energy consumption per value added) in the transport equipment sector

PART II - Target Market Screening

16. Country Ranking for Market Opportunities in the Commercial and Public Service Sector

This section aims to identify the most promising international markets for the export of equipment or service that improves the energy in the commercial and public service sector. About hundred countries are scored on the following four attributes:

A. Electricity Intensity

Electricity intensity in 1999 (electricity consumption per value added expressed in constant 1995 US \$ PPP) is used as an indicator for the energy efficiency in the service sector.

B. Growth Rate of Electricity Consumption

The average growth rate of electricity consumption between 1994 and 1999 in the service sector indicates how fast the potential market for energy efficiency technologies can be expected to grow in the future (assuming unchanged macroeconomic and political conditions).

C. Electricity Consumption

The electricity consumption in the service sector in 1999 (in toe) indicates the size of the market. This attribute can be used as an indicator for the potential replicability of a successful export.

D. Risk

The overall risk factors, which are listed in chapter 3, are used to describe the risk involved with conducting business in foreign markets. The overall risk factors describe the political, economic, legal, tax, operational, and security risk.

Screening Methodology

Countries, for which data was available, were ranked according to the four attributes described above. Electricity consumption (and intensity) was preferred as screening attribute over energy consumption, because electricity consumption depends less than energy consumption on the climate of the country. This is because electricity use usually does not include the contribution of space heating since cheaper fuels than electricity are generally used for space heating. The country ranking reflects, therefore, the country's market opportunity for the export of energy efficiency technologies for the service sector that predominately use electricity as fuel, such as office equipment, lighting, air conditioning, etc.

The individual country rankings for each of the four attributes were combined into an overall ranking using the following formula:

$$R_{TOT} = \sqrt{(w_{EI} \cdot R_{EI}^2) + (w_{EG} \cdot R_{EG}^2) + (w_{EC} \cdot R_{EC}^2) + (w_{RI} \cdot R_{RI}^2)}$$

- with
- R_{TOT} ... Total country ranking in the service sector
 - R_{EI} ... Country ranking according to its electricity intensity in the service sector
 - R_{EG} ... Country ranking according to its electricity growth rate in the service sector
 - R_{EC} ... Country ranking according to its electricity consumption in the service sector
 - R_{RI} ... Country ranking according to its overall risk factor
 - w_{EI} ... Weight factor of R_{EI}
 - w_{EG} ... Weight factor of R_{EG}
 - w_{EC} ... Weight factor of R_{EC}
 - w_{RI} ... Weight factor of R_{RI}

The following weight factors were chosen:

$$w_{EI} = 0.35$$

$$w_{EG} = 0.1$$

$$w_{EC} = 0.25$$

$$w_{RI} = 0.3$$

Screening results:

Country	Ranking	R _{EI}	R _{EG}	R _{EC}	R _{RI}	R _{TOT}
Norway	1	3	53	20	11	20.3
Singapore	2	22	9	37	4	20.8
US	3	14	57	2	13	21.3
Korea (Rep.)	4	24	13	10	27	22.4
Australia	5	30	43	13	9	22.8
Canada	6	4	77	3	3	24.6
Finland	7	10	66	28	7	25.3
Netherlands	8	36	47	16	2	25.7
Poland	9	28	39	19	26	27.0
Portugal	10	35	14	32	19	27.1
Spain	11	44	23	12	16	27.7
Greece	12	31	29	30	24	28.0
New Zealand	13	21	46	42	17	28.5
Japan	14	34	56	1	22	29.2
Saudi Arabia	15	2	41	15	40	29.2
United Kingdom	16	38	65	6	6	29.6
Brunei	17	1	6	59	23	30.2
Sweden	18	8	89	18	12	30.6
Czech Republic	19	20	54	33	29	31.1
Hungary	20	26	52	39	25	32.1
Thailand	21	25	37	17	43	33.5
Slovak Republic	22	19	51	44	31	33.8
Lithuania	23	23	7	52	34	34.2
Brazil	24	29	31	7	47	35.2
France	25	40	82	5	15	35.3
Malaysia	26	11	85	26	30	35.4
Germany	27	51	68	4	8	35.7
Denmark	28	41	72	34	10	36.0
Bulgaria	29	7	2	45	49	37.2
Iceland	30	17	50	76	5	38.8
Panama	31	18	22	51	46	38.9
Belgium	32	58	61	29	18	41.0
Italy	33	61	67	11	20	41.8
Costa Rica	34	43	40	58	32	42.4
Chile	35	62	24	46	21	42.5
Estonia	36	12	71	63	36	43.1
Austria	37	67	36	41	14	43.5
Uruguay	38	56	19	56	33	45.2
Latvia	39	9	80	60	41	45.4
Jamaica	40	15	33	65	51	45.4
South Africa	41	57	74	21	37	46.5
Venezuela	42	5	55	22	68	47.5
Luxembourg	43	55	70	70	1	48.8

Country	Ranking	R _{EI}	R _{EG}	R _{EC}	R _{RI}	R _{TOT}
Lebanon	44	39	11	62	54	49.0
Egypt	45	53	15	36	58	49.7
Trinidad and Tobago	46	54	35	78	28	50.3
Russia	47	37	84	8	61	51.2
Tunisia	48	73	8	54	35	51.8
Jordan	49	48	28	68	50	51.9
Turkey	50	65	63	27	48	52.3
Romania	51	64	25	47	52	53.1
Philippines	52	59	60	31	60	55.1
Bolivia	53	69	18	75	38	56.2
China	54	80	12	9	57	57.0
Argentina	55	68	27	23	65	57.1
Ukraine	56	27	92	38	69	57.1
Cote d'Ivoire	57	49	26	61	66	57.2
Mexico	58	83	75	24	42	58.7
Honduras	59	32	17	71	77	61.0
India	60	85	34	14	62	62.1
Guatemala	61	74	44	64	55	62.2
Moldova	62	13	90	74	71	63.0
Uzbekistan	63	6	69	48	88	63.6
Morocco	64	84	78	55	44	64.1
Ecuador	65	46	30	53	84	64.1
El Salvador	66	66	64	69	64	65.6
Iran	67	50	59	25	89	66.3
Colombia	68	70	48	40	80	67.7
Nigeria	69	33	73	50	90	67.8
Zambia	70	42	83	81	72	67.9
Gabon	71	76	81	90	39	68.0
Paraguay	72	60	10	72	79	68.0
Indonesia	73	81	5	35	78	68.2
Vietnam	74	89	21	66	59	68.4
Benin	75	79	1	91	56	69.2
Belarus	76	16	91	49	93	69.6
Nicaragua	77	52	16	80	83	69.8
Senegal	78	88	45	89	45	70.1
Zimbabwe	79	45	38	57	94	70.3
Cameroon	80	75	32	82	70	71.4
Sri Lanka	81	82	79	67	63	71.6
Armenia	82	47	94	86	73	71.8
Ethiopia	83	87	3	83	67	73.8
Peru	84	93	93	73	53	75.2
Mozambique	85	71	20	87	81	75.4
Pakistan	86	72	42	43	95	75.6
Tanzania	87	63	62	79	86	76.0
Togo	88	78	88	92	76	81.3
Kenya	89	91	87	85	74	82.9
Bangladesh	90	95	58	77	82	83.2

Country	Ranking	R_{EI}	R_{EG}	R_{EC}	R_{RI}	R_{TOT}
Azerbaijan	91	90	95	88	75	84.4
Tajikistan	92	77	86	84	91	85.1
Albania	93	86	49	94	87	85.2
Nepal	94	92	76	93	85	88.0
Haiti	95	94	4	95	92	88.6

Tab. 16.1: Country ranking according to export opportunities of energy efficiency technologies in the service sector

Opportunity – Risk Chart

R_{EI} , R_{EG} , and R_{EC} are combined into a single ranking reflecting the opportunity in a country for the export of energy efficiency technologies. This composite opportunity ranking is applied on the ordinate, while the overall risk ranking is applied on the abscissa.

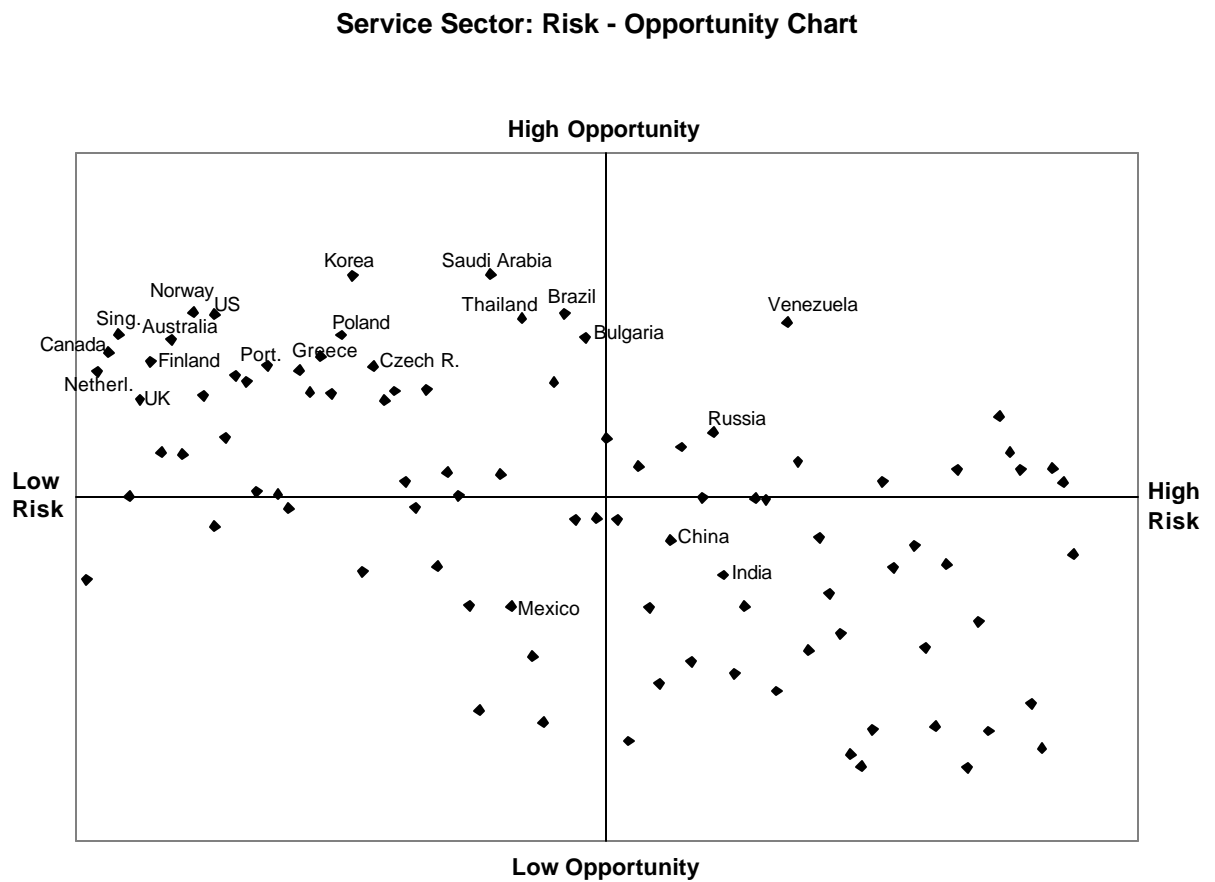


Fig. 16.1: Risk – Opportunity chart for the service sector

17. Country Ranking for Market Opportunities in the Manufacturing Sector

This section aims to identify the most promising international markets for the export of equipment or service that improves the energy efficiency in the manufacturing sector. About hundred countries are scored on the following four attributes:

A. Energy Intensity

Energy intensity in 1999 (energy consumption per value added expressed in constant 1995 US \$ PPP) is an indicator for the energy efficiency in the manufacturing sector.

B. Growth Rate of Energy Consumption

The average growth rate of energy consumption between 1994 and 1999 in the manufacturing sector indicates how fast the potential market for energy efficiency technologies can be expected to grow in the future (assuming unchanged macroeconomic and political conditions).

C. Energy Consumption

The energy consumption in the manufacturing sector in 1999 (in toe) indicates the size of the market. This attribute can be used as an indicator for the potential replicability of a successful export.

D. Risk

The overall risk factors, which are listed in chapter 3, are used to describe the risk involved with conducting business in foreign markets. The overall risk factors describe the political, economic, legal, tax, operational, and security risk.

Screening Methodology

Countries, for which data was available, were ranked according to the four attributes described above. The individual country rankings for each of the four attributes were combined into an overall ranking using the following formula:

$$R_{TOT} = \sqrt{(w_{EI} \cdot R_{EI}^2) + (w_{EG} \cdot R_{EG}^2) + (w_{EC} \cdot R_{EC}^2) + (w_{RI} \cdot R_{RI}^2)}$$

with R_{TOT} ... Total country ranking in the manufacturing sector

R_{EI} ... Country ranking according to its energy intensity in the manufacturing sector

R_{EG} ... Country ranking according to its energy growth rate in the manufacturing sector

R_{EC} ... Country ranking according to its energy consumption in the manufacturing sector

R_{RI} ... Country ranking according to its overall risk factor

w_{EI} ... Weight factor of R_{EI}

w_{EG} ... Weight factor of R_{EG}

w_{EC} ... Weight factor of R_{EC}

w_{RI} ... Weight factor of R_{RI}

The following weight factors were chosen:

$$w_{EI} = 0.35$$

$$w_{EG} = 0.1$$

$$w_{EC} = 0.25$$

$$w_{RI} = 0.3$$

Screening results:

Country	Ranking	R _{EI}	R _{EG}	R _{EC}	R _{RI}	R _{TOT}
Canada	1	23	62	8	3	24.3
Finland	2	25	39	31	7	25.0
Belgium	3	32	29	23	18	25.9
Australia	4	27	57	18	9	26.2
Saudi Arabia	5	10	5	26	40	26.2
Trinidad and Tobago	6	1	10	45	27	27.1
South Africa	7	31	19	17	36	28.9
Norway	8	17	63	36	11	29.3
New Zealand	9	20	40	44	17	29.5
Chile	10	36	13	41	21	32.0
Netherlands	11	39	69	20	2	33.3
Korea (Rep.)	12	50	23	9	26	33.9
United Kingdom	13	45	70	12	6	35.3
Sweden	14	38	72	29	12	35.7
Brazil	15	43	35	7	47	38.0
Spain	16	59	34	15	16	38.3
Slovak Republic	17	22	79	42	30	38.8
Portugal	18	52	28	40	19	39.2
Malaysia	19	53	24	32	29	39.4
Egypt	20	35	20	30	60	42.1
Iceland	21	15	15	82	5	42.3
France	22	63	56	10	15	42.4
Syria	23	13	3	50	61	42.4
Greece	24	49	49	48	23	42.6
Venezuela	25	7	51	24	71	44.0
Czech Republic	26	42	90	33	28	44.0
Singapore	27	62	8	49	4	44.2
Poland	28	54	82	19	25	44.4
Russian Federation	29	11	87	3	64	45.1
Turkey	30	58	16	25	48	45.3
Bolivia	31	34	14	72	38	46.4
Japan	32	67	66	4	22	46.4
Bulgaria	33	18	91	47	49	47.1
Germany	34	69	74	6	8	47.4
Luxembourg	35	26	89	70	1	47.5
Ukraine	36	12	88	13	72	49.2
Lebanon	37	16	45	69	56	49.2
Italy	38	73	65	11	20	49.4
India	39	41	78	5	65	49.7
Jordan	40	37	32	71	50	50.9
United States	41	78	71	1	13	51.8
Latvia	42	47	26	74	41	52.1
Mexico	43	64	85	14	42	52.3
Gabon	44	8	50	90	39	52.5
Thailand	45	74	41	22	43	52.5

Country	Ranking	R _{EI}	R _{EG}	R _{EC}	R _{RI}	R _{TOT}
Lithuania	46	44	86	64	33	52.6
Austria	47	77	42	43	14	52.7
Jamaica	48	30	38	80	52	53.6
Iran	49	21	25	16	93	53.6
Argentina	50	61	31	27	68	54.5
Zambia	51	4	60	65	74	55.4
Nigeria	52	2	48	35	92	55.5
Peru	53	65	7	53	55	55.6
Romania	54	56	94	34	53	55.8
Estonia	55	33	96	78	35	56.5
Cameroon	56	28	52	66	73	56.9
China	57	66	83	2	59	57.1
Paraguay	58	24	43	61	81	57.3
Kenya	59	19	64	63	77	57.5
Hungary	60	76	80	46	24	58.0
Panama	61	40	59	89	46	59.4
Denmark	62	80	73	55	10	59.7
Tunisia	63	79	36	60	34	59.7
Mozambique	64	6	77	59	84	59.9
Azerbaijan	65	9	97	57	78	60.1
Belarus	66	14	58	39	97	60.1
Senegal	67	57	17	88	45	60.9
Colombia	68	51	61	38	83	60.9
Pakistan	69	29	53	28	99	60.9
Sri Lanka	70	68	2	58	66	61.4
Ghana	71	55	84	75	51	62.9
Morocco	72	86	12	56	44	63.0
Armenia	73	46	9	85	75	65.1
Philippines	74	88	11	37	63	65.2
Dominican Republic	75	84	21	67	54	67.2
Kyrgyzstan	76	5	95	87	76	67.4
Indonesia	77	85	44	21	80	68.9
Guatemala	78	81	46	73	57	69.4
Angola	79	3	81	77	96	70.0
Honduras	80	48	76	79	82	70.4
Algeria	81	60	75	54	90	70.6
Uruguay	82	92	55	81	32	72.2
Vietnam	83	94	54	52	62	72.2
Ecuador	84	72	47	62	87	72.6
Bangladesh	85	82	37	51	85	72.9
El Salvador	86	87	30	76	67	74.4
Costa Rica	87	96	67	83	31	75.4
Nicaragua	88	70	27	91	86	78.0
Nepal	89	75	4	86	89	78.7
Benin	90	90	1	97	58	78.7
Zimbabwe	91	71	68	68	98	79.1
Ethiopia	92	93	18	93	70	81.8
Cote d'Ivoire	93	97	22	92	69	83.0

Country	Ranking	R_{EI}	R_{EG}	R_{EC}	R_{RI}	R_{TOT}
Togo	94	91	6	96	79	84.1
Namibia	95	99	99	99	37	85.3
Tajikistan	96	83	93	84	94	87.7
Yemen	97	95	33	94	88	88.3
Albania	98	89	92	95	91	91.4
Congo, Rep.	99	98	98	98	95	97.1

Tab. 17.1: Country ranking according to export opportunities of energy efficiency technologies in the manufacturing sector

Opportunity – Risk Chart

R_{EI} , R_{EG} , and R_{EC} are combined into a single ranking reflecting the opportunity in a country for the export of energy efficiency technologies. This composite opportunity ranking is applied on the ordinate, while the overall risk ranking is applied on the abscissa.

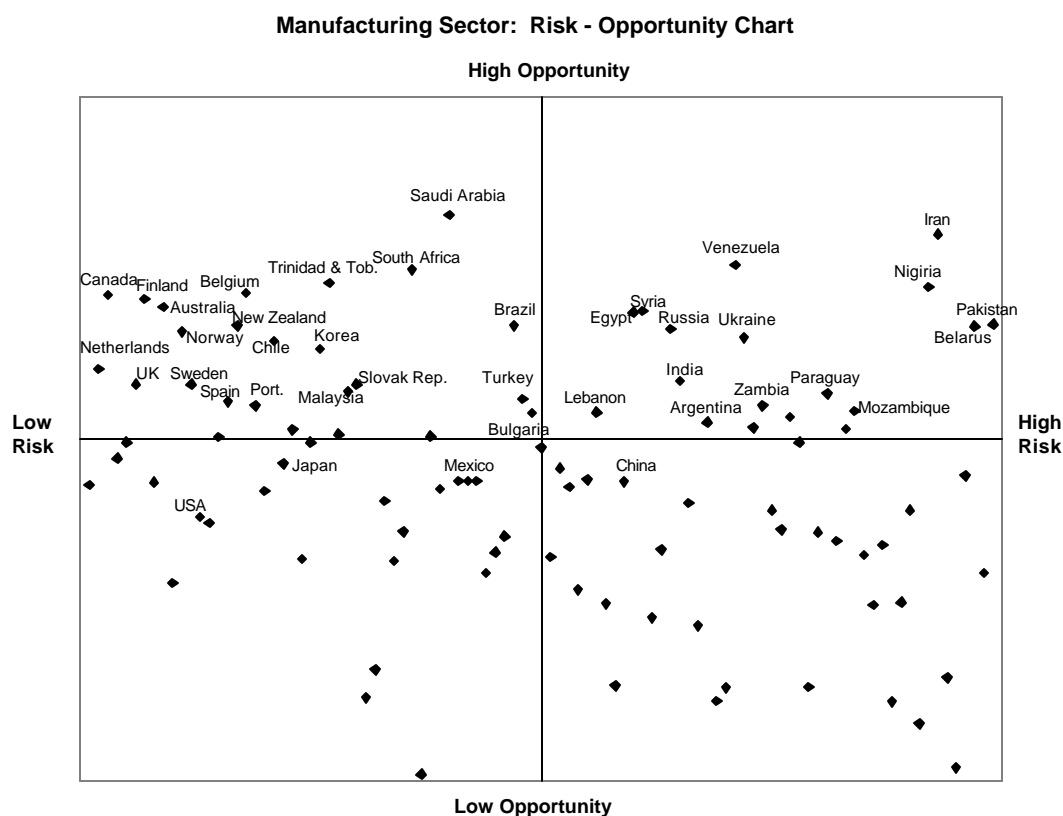


Fig. 17.2: Risk – Opportunity chart for the manufacturing sector

Shortcoming of this screening analysis:

The screening analysis is based on only four attributes, namely energy intensity, energy consumption, growth rate of energy consumption, and economic and political risk. Energy intensity and consumption are measured for the whole manufacturing sector. This leads to a biased ranking where countries with a high share of energy intensive industry sectors, such as the chemical, petrochemical, or aluminum production sectors, get a very high ranking. Highly ranked countries, such as for example Saudi Arabia or Trinidad and Tobago, must therefore not necessarily be energy inefficient. The high ranking may simply reflect the high share of energy intensive sectors within the total manufacturing sector. On the other hand, countries that have a low ranking must not necessarily be energy efficient. The low ranking may be due to a lack of energy intensive industries in that country. One example is Thailand. Thailand is not included in the top 40 countries mainly because it has very little energy intensive industry. The sectoral analysis of chapters 6 to 15, however, show that Thailand scores extremely high in several manufacturing sectors, such as the food, textile, or mineral industry.

To get a better ranking reflecting the potential for energy efficiency improvement potentials, it would be necessary to adjust for the industrial structure of the countries. For this, one would need the shares of all manufacturing sub-sectors in the total manufacturing sector (based on value added) and calculate the energy intensity and energy consumption for each country with a hypothetical industry structure, which is the same for all analyzed countries, and may be the average industry structure of all analyzed countries or the structure of a specific reference country.

Such an adjustment has been made by Shipper et al. (2001) for the energy intensity of the manufacturing industry in thirteen OECD countries (Fig. 17.1).

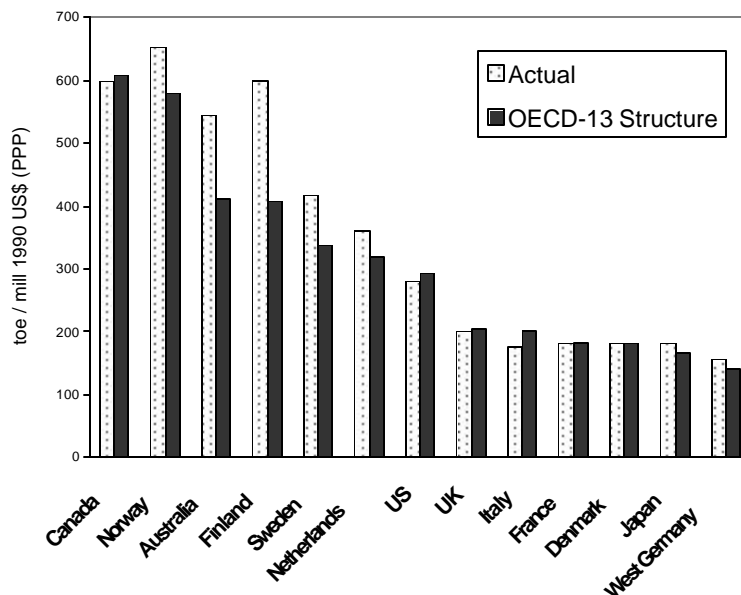


Fig. 17.1: Energy intensity in the manufacturing industry in thirteen OECD countries in 1990: actual and adjusted to OECD-13 structure (Shipper et al., 2001).

Since data about value added of all manufacturing sectors of all analyzed countries was not available, a structural adjustment could not be done. One should, therefore, bear in mind that highly ranked countries may be on top of the list just because of a high share of energy intensive industries and low ranked countries may have certain very energy inefficient sectors.

Part III – Priority Markets

18. Country Notes for Priority Markets in the Commercial and Public Service Sector

In this chapter, some of the most promising markets for the export of energy efficiency products for the service sector, which were identified by the screening analysis in part II of this work and for which necessary data was available, will be analyzed in more detail.

These markets are:

Australia
Canada
Korea (Republic of)
Norway
Singapore

US (for comparison only)

18.1 Summary (Comparison of the Target Markets):

Country	Energy Intensity	Price of Electricity [US cents / kWh]	Growth Rate of Electricity Use 1994 to 1999	Market Size (Electricity Use [GWh])	Energy Efficiency Policies in Place	Opportunities for Carbon Credits (Total CO ₂ emissions per GDP [g CO ₂ / US\$ PPP])	Financing [Gross fixed capital formation per capita in 2000 (current US\$)]	Risk (1..9) (1 = min., 9 = max.)
Australia	Low energy intensity, low electricity intensity, due to mild climate and relatively high energy efficiency status.	4.9	5.2 %	40,391	Many	771	4,269	1.88
Canada	Very high energy intensity, very high electricity intensity.	5.8 – 6.5	1.6 %	125,900	Many	570	4,578	1.67
Korea	Average energy intensity. Likely to increase due to economic development.	8.6	10.3 %	57,243	Several	639	2,788	3.19
Norway	High energy intensity, mainly due to high heating and lighting demand. Energy efficiency status is very high.	5.6	3.8 %	22,039	Many	312	7,125	2.0
Singapore	Low energy intensity, but very high electricity intensity (due to high cooling demand). Good potential for energy efficiency improvements.	8.0	11.6 %	8,885	Several	662	6,794	1.67

Note: For definitions and more detailed information see 18.2 – 18.7

Rating of Target Markets in Terms of Export Opportunities for Energy-efficiency Technologies:

Country	Energy Efficiency Potential	Price of Electricity	Growth Rate of Electricity Use	Market Size	Energy Efficiency Policies	Carbon Credits	Financing	Risk
Australia	**	*	***	*****	*****	*****	*****	*****
Canada	*****	***	*	*****	*****	***	*****	*****
Korea	****	*****	*****	*****	****	****	****	****
Norway	**	**	**	***	*****	*	*****	*****
Singapore	****	****	*****	*	****	****	*****	*****

***** Very favorable
 **** Favorable
 *** Medium
 ** Unfavorable
 * Very unfavorable

Rating system used:

Rating	Energy Intensity Potential for energy efficiency improvements	Price of electricity [US cents / kWh]	Growth Rate [%] of Electricity Use 1994 to 1999	Market Size (Electricity use [GWh])	Energy Efficiency Policies in Place	Carbon Credits (Total CO ₂ emissions per GDP [g CO ₂ / US\$ PPP])	Financing (Gross fixed capital formation per capita in 2000 [current US\$])	Risk (1 ... 9) (1 = min., 9 = max.)
*****	High	> 8.0	> 8.0	> 40,000	Many	> 700	> 5,000	= 2.50
****	Good	7.1 ... 8.0	6.1 ... 8.0	30,001 ... 40,000	Several	601 ... 700	2,001 ... 5,000	2.51 ... 3.50
***	Some	6.1 ... 7.0	4.1 ... 6.0	20,001 ... 30,000	Some	501 ... 600	1,001 ... 2,000	3.51 ... 4.50
**	Little	5.1 ... 6.0	2.1 ... 4.0	10,001 ... 20,000	Few	401 ... 500	501 ... 1,000	4.51 ... 5.50
*	Limited	= 5.0	= 2.0	= 10,000	None	= 400	= 500	> 5.50

18.2 Australia

18.2.1 Energy Efficiency Status

By international comparison, Australia has a low energy and electricity intensity in its commercial and service sector. This is in spite of the fact that Australia's commercial and service sector has high floor area relative to value added. The low energy and electricity intensity may be explained by very low heating demand due to the mild climate, low lighting needs, and relatively energy efficient equipment used. The following table compares energy and electricity intensities in the commercial and public service sectors of Australia with the US and Japan in 1999.

	Australia	USA	Japan
Energy use [toe] per value added [mill 1995 US\$ PPP]	16	33	22
Energy use [koe] per employee	688	1,718	1,031
Energy use [koe] per floor space [m ²]	12.5*	23.1	26.9
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	134	196	123
Electricity use [kWh] per employee	5,680	10,180	5,818
Electricity use [kWh] per floor space [m ²]	100*	149	152

Tab. 18.2.1: Energy and electricity intensities in the commercial and public service sector in Australia, USA, and Japan in 1999.

* Note: Data for 1995.

Sources: International Energy Agency, World Bank, US Department of Energy, Schipper (2000).

18.2.2 Price of Electricity

Price for electricity for commercial customers in 1998:

AUD 0.078 / kWh = US\$ 0.049 / kWh

Source: Deepak Sharma, "The multidimensionality of electricity reform – an Australian perspective," *Energy Policy* 31 (2003) 1093-1102.

18.2.3 Growth Rate of Electricity Consumption

The electricity consumption grew by 5.2% on average between 1994 and 1999.

18.2.4 Potential Replicability of Exports (Size of Market)

Number of business entities in the Australian service sector in 1998-1999: 1,497,000 (Source: Australian Bureau of Statistics).

The total electricity consumption was 40,391 GWh in 1999.

18.2.5 Energy Efficiency Policies

In recent years, the Australian government has undertaken a number of initiatives to encourage improvements in energy efficiency. These include:

- The Energy Efficiency Best Practice Program. The Australian government launched this program in mid-1998. The program is scheduled to run over a five-year period with government funding of AU\$ 10.3 million. It assists targeted industries to reduce their greenhouse gas emissions through improving energy efficiency, while also reducing costs and increasing productivity. Program activities include training, energy surveys and data collection; good practice guides and good-practice case studies.
- Improving Energy Efficiency in Commonwealth Operations, introduced in 1997. The Australian government has made a commitment to lead by example and reduce the intensity of energy use in Commonwealth operations. Overall responsibility of the policy rests with the Department of Industry, Science and Resources (DISR). The cumulative reduction in total Commonwealth energy consumption since the first reporting period in 1997/98 was more than 10 per cent, and associated greenhouse gas emissions were reduced by more than 9 per cent.
- The Greenhouse Challenge program is a joint voluntary initiative between the Commonwealth government and industry in Australia to abate greenhouse gas emissions, but much of its activity focuses on energy-efficient technologies and processes. The Greenhouse Challenge program is open to large industrial firms. Smaller businesses can participate through another program called Greenhouse Allies. Under the Greenhouse Allies program, large Greenhouse Challenge members mentor smaller firms through a group process in order to help them reduce their emissions.
- Mandatory minimum efficiency standards. Recent developments in this area include:
 - The introduction as of 1999 of minimum energy performance standards for refrigerators, freezers and electric water heaters; as well as the development of minimum energy performance standards for electric motors, lighting ballasts and air-conditioners for implementation in 2001 and 2002.

- Preparatory work for the introduction of mandatory energy efficiency standards for buildings into the Building Code of Australia. In March 1999, the federal government and the building industry, represented by the Australian Building Energy Council (ABEC), agreed on a comprehensive strategy to make Australia more energy-efficient. ABEC, supported by the AGO, is developing a “Voluntary Code of Practice for Energy Efficient Building Design” for new buildings which will describe best practice and encourage designers to go beyond the minimum requirements. The AGO estimated in 1999 that in the absence of any such measures, the energy consumption of residential buildings could grow by 40 per cent between 1990 and 2010, leading to a 17 per cent increase in greenhouse gas emissions. The energy use in non-residential buildings could even increase by 91 per cent, leading to a 94 per cent growth in CO₂ equivalent emissions, or 62.8 million tonnes of CO₂ equivalent from commercial buildings alone in 2010.

Further information can be found in:

- Deni Greene and Alan Pears, “Policy Options for Energy Efficiency in Australia,” ACRE (The Australian CRC for Renewable Energy), January 2003.
<<http://www.acre.ee.unsw.edu.au/downloads/AEPG%20Energy%20Efficiency%20report%20-%202003.pdf>>
- International Energy Agency: Energy Policies of IEA Countries. Australia 2001 Review.
<<http://www.iea.org/books/countries/2001/australia.pdf>>
- International Energy Agency: Energy Efficiency Update for Australia
<<http://www.iea.org/pubs/newslett/eneeff/Au.pdf>>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

18.2.6 Carbon Credits

Australia’s total carbon dioxide emissions per GDP were 771 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is high on an international comparison.

Australia’s greenhouse gas emissions measured on a per capita basis are among the highest in the world. This is due to significant land clearing for agricultural activities,

high vehicle usage due to long distances of travel, high proportion of coal use in electricity generation, and many energy intensive manufacturing industries. For this reason, the Australian government is active in supporting greenhouse emission mitigation through various programs and initiatives. Australia is also host of several organizations and businesses dealing with greenhouse gas emissions trading.

For these reasons, there are relative good opportunities for obtaining carbon credits for energy efficiency projects.

18.2.7 Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 4,269

18.2.8 Risk

Political risk:	2
Economic risk:	2
Legal risk:	1
Tax risk:	2
Operational risk:	2
Security risk:	2

Overall risk: 1.88

Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

18.3 Canada

18.3.1 Energy Efficiency Status

In this analysis, the Canadian commercial and public service sector includes activities related to trade, finance, real estate, public administration, education, tourism, and street lighting. Energy consumption in the Canadian commercial and public service sector has increased by 22 % between 1990 and 2000, or by 2.2 % annually on average.

The main driver of the increase in energy use was the growth of activity in the commercial and public service sector. Energy efficiency improvements, weather and structural changes had minor effects. Fig. 18.3.1 depicts the relative importance of the main drivers of the growth in energy consumption:

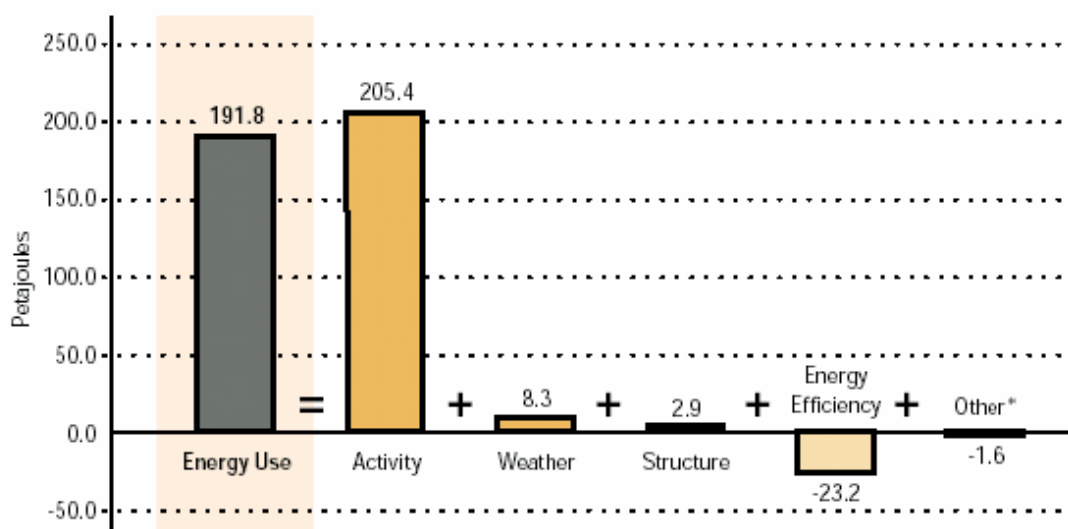


Fig. 18.3.1: Impact of activity, weather, structure, and energy efficiency on the increase in energy use in the Canadian commercial and public service sector between 1990 and 2000.

*Note: Street lighting is not included in the factorization but is included in “Energy Use.”

Source: Energy Efficiency Trends in Canada 1990 to 2000. Natural Resources Canada, Office of Energy Efficiency, June 2002.

Tab. 18.3.2 shows that the main fuel types used in 2000 were natural gas at 46% and electricity at 43%. Tab. 18.3.3 shows that offices and the retail sector are the highest energy consumers within the commercial and public service sector. The most energy intensive sectors are food service and food retail, health care, and hotels and restaurants (see Tab. 18.3.5 and 18.3.6). Space heating is generally by far the most energy intensive end use (see Tab. 18.3.6).

Canada's commercial and public service sector has in total a very high energy intensity by international comparison.

The following table compares energy and electricity intensities in the commercial and public service sectors of Canada with the US and Japan in 1999.

	Canada	USA	Japan
Energy use [toe] per value added [mill 1995 US\$ PPP]	58	33	22
Energy use [koe] per employee	2,055	1,718	1,031
Energy use [koe] per floor space [m ²]	42.5	23.1	26.9
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	286	196	123
Electricity use [kWh] per employee	10,070	10,180	5,818
Electricity use [kWh] per floor space [m ²]	221	149	152

Tab. 18.3.1: Energy and electricity intensities in the commercial and public service sector in Canada, USA, and Japan in 1999.

Sources: International Energy Agency, World Bank, Natural Resources Canada, Statistics Canada, US Department of Energy

Energy use by year and fuel type:

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average annual growth rate between 1990 and 2000 [%]
Total fuel	867	888.9	901	933	928	960.9	981.5	999	944.1	979.2	1,058.8	2.2
Electricity	390.1	398	398	408	410	421.2	426.9	437	431.3	436.8	453.1	1.6
Natural gas	387.1	403.4	417	433	420	427.6	451.2	453	418.5	443.8	488.5	2.6
Propane	16.1	18.3	18.6	22.8	33.1	41.8	34.3	39.3	29.5	34.3	36.1	12.4
Light fuel oil and kerosene	62	58.1	56.9	57.7	52.4	61.2	59.7	57.5	47.6	47	60.4	-0.3
Heavy fuel oil	11.4	11	11.5	11.2	11.9	8.6	9	11.8	16.8	17	19.8	7.4
Other fuels	0.4	0.2	0	0.3	0.5	0.5	0.4	0.6	0.4	0.3	1	15.0

Tab. 18.3.2: Energy use in total Canadian service sector by year and fuel type. Unit: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Energy use by fuel source and service sector:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
All buildings	1,058.80	453.1	488.5	36.1	60.4	19.8	1
Schools	147.8	36.5	87.5	7.6	12.2	3.8	0.1
Health	124.8	37.6	68.5	3.6	11	3.9	0.1
Religious	12	3.1	7	0.4	1.2	0.4	0
Other institutions	44	12.7	25.8	1.4	3	1	0.1
Offices	261.2	117.8	116.9	9	13	4.3	0.3
Retail	254.4	141.6	93.9	7.2	8.2	3.2	0.2
Hotels and restaurants	90.2	46.5	34.8	3.6	3.9	1.4	0.1
Recreation	64.5	26.8	30.3	1.7	4.8	0.8	0.1
Warehouses	52.6	23.3	23.8	1.5	3	1	0.1

Tab. 18.3.3: Energy use by fuel source and service sector in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Energy use by end use and fuel type:

All buildings:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	1,058.80	453.1	488.5	36.1	60.4	19.8	1
Lighting	151.2	151.2	0	0	0	0	0
Space cooling	46.1	39	7.2	0	0	0	0
Auxiliary motor	120.8	120.8	0	0	0	0	0
Auxiliary equipment	78.5	66.4	4.7	4.5	1	1.8	0
Space heating	550.8	63.1	390.3	31.5	49.4	15.4	1
Water heating	104.1	5.2	86.2	0	10	2.6	0
Street lighting	7.3	7.3	0	0	0	0	0

Tab. 18.3.4.a: Energy use in Canadian service sectors (all buildings) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Schools:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	147.8	36.5	87.5	7.6	12.2	3.8	0.1
Lighting	11.7	11.7	0	0	0	0	0
Space cooling	2.4	2	0.4	0	0	0	0
Auxiliary motor	8.5	8.5	0	0	0	0	0
Auxiliary equipment	2.5	2.2	0.1	0.1	0	0.1	0
Space heating	109.9	11.4	76.6	7.5	10.8	3.5	0.1
Water heating	12.7	0.7	10.4	0	1.4	0.3	0

Tab. 18.3.4.b: Energy use in Canadian service sectors (schools) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Health sector:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	124.8	37.6	68.5	3.6	11	3.9	0.1
Lighting	12.2	12.2	0	0	0	0	0
Space cooling	2.9	2.4	0.4	0	0	0	0
Auxiliary motor	9.2	9.2	0	0	0	0	0
Auxiliary equipment	5.2	4.5	0.3	0.2	0.1	0.1	0
Space heating	61.3	7.7	40.9	3.4	6.6	2.6	0.1
Water heating	34	1.6	26.9	0	4.3	1.2	0

Tab. 18.3.4.c: Energy use in Canadian service sectors (health sector) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Religious sector:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	12	3.1	7	0.4	1.2	0.4	0
Lighting	1.4	1.4	0	0	0	0	0
Space cooling	0.1	0.1	0	0	0	0	0
Auxiliary motor	0.8	0.8	0	0	0	0	0
Auxiliary equipment	0	0	0	0	0	0	0
Space heating	7.9	0.8	5.5	0.4	0.9	0.3	0
Water heating	1.9	0.1	1.5	0	0.2	0.1	0

Tab. 18.3.4.d: Energy use in Canadian service sectors (religious sector) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Offices:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	261.2	117.8	116.9	9	13	4.3	0.3
Lighting	46	46	0	0	0	0	0
Space cooling	11.7	9.9	1.8	0	0	0	0
Auxiliary motor	22.2	22.2	0	0	0	0	0
Auxiliary equipment	26.5	23.2	1.1	1.1	0.3	0.6	0
Space heating	143.7	16	104.2	7.8	12	3.4	0.3
Water heating	11.2	0.5	9.8	0	0.7	0.3	0

Tab. 18.3.4.e: Energy use in Canadian service sectors (offices) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Retail sector:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	254.4	141.6	93.9	7.2	8.2	3.2	0.2
Lighting	47.1	47.1	0	0	0	0	0
Space cooling	17.2	14.5	2.7	0	0	0	0
Auxiliary motor	47.7	47.7	0	0	0	0	0
Auxiliary equipment	20.6	18	0.9	0.9	0.2	0.5	0
Space heating	106.1	13.4	76.6	6.3	6.9	2.6	0.2
Water heating	15.7	0.8	13.7	0	1	0.2	0

Tab. 18.3.4.f: Energy use in Canadian service sectors (retail sector) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Hotel and restaurants:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	90.2	46.5	34.8	3.6	3.9	1.4	0.1
Lighting	10.3	10.3	0	0	0	0	0
Space cooling	8.7	7.4	1.4	0	0	0	0
Auxiliary motor	5.9	5.9	0	0	0	0	0
Auxiliary equipment	23.8	18.5	2.3	2.2	0.3	0.6	0
Space heating	26.9	3.6	18.8	1.4	2.4	0.6	0.1
Water heating	14.6	0.8	12.3	0	1.2	0.3	0

Tab. 18.3.4.g: Energy use in Canadian service sectors (hotels and restaurants) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Recreation sector:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	64.5	26.8	30.3	1.7	4.8	0.8	0.1
Lighting	8.3	8.3	0	0	0	0	0
Space cooling	0.3	0.3	0.1	0	0	0	0
Auxiliary motor	13.8	13.8	0	0	0	0	0
Auxiliary equipment	0	0	0	0	0	0	0
Space heating	34.8	4	24	1.7	4.2	0.7	0.1
Water heating	7.3	0.4	6.2	0	0.6	0.1	0

Tab. 18.3.4.h: Energy use in Canadian service sectors (recreation sector) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Warehouses:

	Total fuel	Electricity	Natural gas	Propane	Light fuel oil and kerosene	Heavy fuel oil	Other fuels
Total end use	52.6	23.3	23.8	1.5	3	1	0.1
Lighting	10.5	10.5	0	0	0	0	0
Space cooling	0.7	0.6	0.1	0	0	0	0
Auxiliary motor	8.5	8.5	0	0	0	0	0
Auxiliary equipment	0	0	0	0	0	0	0
Space heating	30.9	3.6	22	1.5	2.8	0.9	0.1
Water heating	2	0.1	1.7	0	0.2	0	0

Tab. 18.3.4.i: Energy use in Canadian service sectors (warehouses) in 2000. Units: PJ.
Source: Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

Energy and electric ity intensity by building characteristics in 2000:

	Total energy intensity [GJ/m ²]	Total electricity intensity [GJ/m ²]
All buildings in Canada	1.59	0.73
Building floor space		
93-464 m ² (1000-4999 sq. ft.)	2.06	0.98
465-929 m ² (5000-9999 sq. ft.)	1.80	0.70
929-4645 m ² (10000-49999 sq. ft.)	1.35	0.58
4645-9290 m ² (50000-99999 sq. ft.)	1.18	0.63
9290 m ² and more (100000 sq. ft. and more)	1.77	0.83
Year of construction		
Before 1920	1.43	0.64
1920-1959	1.68	0.78
1960-1969	1.64	0.61
1970-1979	1.83	0.77
1980-1989	1.36	0.72
1990-1999	1.33	0.77
Number of floors		
1	1.42	0.62
2	1.38	0.64
3	1.29	0.60
4-9	1.52	0.78
10 and more	2.42	1.03
Predominant type of windows		
Single glaze	1.45	0.62
Double glaze	1.62	0.75
Triple glaze	1.42	0.78
Predominant exterior wall type		
Curtain walls	1.53	0.87
Metal stud framing with surface insulation	2.38	0.84
Metal stud framing without surface insulation	1.10	0.44
Wood frame walls with surface insulation	1.63	0.63
Wood frame walls without surface insulation	1.58	0.46
Concrete block with interior finishing	1.49	0.75
Concrete block without interior finishing	1.33	0.59
Precast panels	1.64	0.83
Unknown	1.08	0.55
Predominant roof type		
Attic roof fully insulated	1.20	0.68
Attic roof partially insulated	1.82	0.77
Attic roof roof not insulated	1.78	0.71
Insulated wood truss roof	1.34	0.63
Not insulated wood truss roof	2.08	0.68
Insulated metal truss roof	1.25	0.61
Not insulated metal truss roof	1.40	0.58
Insulated deck type roof	1.80	0.83
Not insulated deck type roof	1.52	0.52
Unknown	1.27	0.62

	Total energy intensity [GJ/m ²]	Total electricity intensity [GJ/m ²]
Principal building activity		
Commercial and institutional accommodation	1.58	0.53
Entertainment and recreation	1.66	0.93
Office	2.08	0.97
Food retails	2.79	1.86
Non food retails	1.35	0.52
Food service	3.34	1.34
Non food service	1.38	0.58
Shopping malls	1.32	0.72
Warehouse/wholesale	1.32	0.79
Administration	1.61	0.82
Education	0.94	0.40
Health care	2.46	0.93
Public assembly	1.47	0.55
Other	1.19	0.58
Number of workers		
Less than 5	1.29	0.59
5-9	1.30	0.57
10-19	1.55	0.61
20-49	1.37	0.65
50-99	1.52	0.70
100-249	1.42	0.69
250 and more	1.83	0.86
Weekly hours of operation		
Less than 40	1.09	0.43
40-48	1.22	0.56
49-60	1.34	0.70
61-84	1.86	0.77
85-167	1.55	0.79
Open continuously	2.15	0.97
Building ownership		
Private individual(s)	2.16	0.87
Private organization	1.52	0.82
Non-profit organization	1.27	0.47
Fed-prov-muni-regional government	1.38	0.59
Building conservation features		
Reflective or shading film	1.79	0.86
Awnings or blinds	1.70	0.78
Lighting conservation features		
Reflectors	1.83	0.81
Energy efficient ballast	1.66	0.77
Daylight controls	1.37	0.66
Occupancy sensors	1.65	0.90
Time clocks	1.53	0.79
Manual dimmer switches	2.02	0.92
Energy efficient lamps	1.70	0.80
Other	1.53	0.77

	Total energy intensity [GJ/m ²]	Total electricity intensity [GJ/m ²]
Heating/cooling conservation features		
Variable air volume system	1.79	0.81
Outdoor air economizer	1.47	0.75
Temperature setback	1.46	0.75
Equipment reset	1.73	0.77
Heat recovery system	1.61	0.84
Regular maintenance	1.61	0.75
Percentage of the floorspace heated		
Less than 1	0.79	0.79
1-50	1.31	0.68
51-99	1.66	0.91
100	1.59	0.72
Energy sources for heating (more than one may apply)		
Electricity	1.36	0.76
Natural gas	1.73	0.73
Fuel/heating oil	1.42	0.46
Composite	3.51	1.07
Main energy source for heating		
Electricity	1.25	0.88
Natural gas	1.70	0.68
Fuel/heating oil	1.07	0.44
Composite	2.49	0.95
Heating equipment (more than one may apply)		
Furnaces	1.60	0.64
Heat pumps	1.38	0.82
Individual space heaters	1.41	0.75
Boilers	1.68	0.71
Packaged heating units	1.41	0.70
District steam or hot water or other	1.88	0.95
Main heating equipment		
Furnaces	1.50	0.65
Heat pumps	1.17	0.78
Individual space heaters	1.27	0.74
Boilers	1.66	0.67
Packaged heating units	1.50	0.77
District steam or hot water or other	2.35	1.23
Not heated	0.79	0.79
Percentage of the floorspace cooled		
Not cooled	1.16	0.37
1-50	1.29	0.56
51-99	1.63	0.88
100	1.87	0.87
Space cooling energy sources		
Electricity	1.68	0.81
Natural gas	1.47	0.64
Fuel/heating oil	1.75	1.03
Composite	1.92	0.79

	Total energy intensity [GJ/m ²]	Total electricity intensity [GJ/m ²]
Cooling equipment (more than one may apply)		
Residential type air conditioners	1.51	0.66
Heat pumps	1.42	0.73
Individual room air conditioners	1.58	0.79
District chilled water from outside source	1.92	0.77
Central chillers	2.08	0.95
Packaged air conditioning units	1.53	0.78
Swamp coolers	2.16	0.87
Composite	2.94	0.98
Other	3.84	1.14
Main cooling equipment		
Residential type air conditioners	1.43	0.63
Heat pumps	1.20	0.71
Individual room air conditioners	1.26	0.53
District chilled water from outside source	2.02	0.74
Central chillers	1.84	0.92
Packaged air conditioning units	1.44	0.74
Composite	3.06	1.05
Not cooled	1.16	0.37
Energy sources for water heating		
Electricity	1.30	0.76
Natural gas	1.53	0.69
Fuel/heating oil	1.20	0.49
Composite	3.83	1.07
Not heated	1.03	0.59

Tab. 18.3.6: Energy and electricity intensity [GJ/m²] by building characteristics in the Canadian commercial and public service sector in 2000.

Source: Commercial and Institutional Building Energy Use Survey (CIBEUS) 2000, Office of Energy Efficiency, Natural Resources Canada. The CIBEUS target population included all buildings with an area of at least 1,000 square feet, of which 50% or more is devoted to commercial or institutional activities, located in Census Metropolitan Areas or Census Agglomerations with a population of 175,000 or greater. The threshold was a population of 50,000 or greater in the four Atlantic provinces.

Note: Energy intensities in this table may differ from those in Tab. 18.3.7 because of different surveys used to generate the data.

The following table lists energy intensity broken down by service sector and type of end use:

	All buildings	Schools	Health	Religious	Other institutions	Offices	Retail	Hotels and restaurants	Recreation	Warehouses
Total end use	1.82	1.72	3.19	1.29	1.64	1.57	1.97	2.84	1.83	0.96
Lighting	0.26	0.14	0.31	0.15	0.14	0.28	0.36	0.32	0.24	0.19
Space cooling	0.08	0.03	0.07	0.01	0.08	0.07	0.13	0.27	0.01	0.01
Auxiliary motor	0.21	0.1	0.24	0.08	0.16	0.13	0.37	0.18	0.39	0.16
Auxiliary equipment	0.14	0.03	0.13	0	0	0.16	0.16	0.75	0	0
Space heating	0.95	1.28	1.57	0.85	1.09	0.87	0.82	0.85	0.99	0.56
Water heating	0.18	0.15	0.87	0.2	0.17	0.07	0.12	0.46	0.21	0.04

Tab. 18.3.7: Energy intensity [GJ/m²] in the Canadian commercial and public service sector in 1999 broken down by service sector and type of end use.

Source: National Energy Use Data Base, Office of Energy Efficiency, Natural Resources Canada and Statistics Canada.

18.3.2. Price of Energy

Prices for the commercial sector in 2001:

Electricity:	0.0575 ... 0.0646 US\$/kWh
Natural gas:	0.2248 US\$/m ³
Light Fuel Oil:	0.23 US\$/liter
Heavy Fuel Oil:	0.1738 US\$/liter

Source: Natural Resources Canada, Office of Energy Efficiency
<http://oee1.NRCan.gc.ca/neud/dpa/handbook_com_ca.cfm>

18.3.3. Growth Rate of Energy and Electricity Consumption

The energy and electricity consumption grew by 2.2 % and 1.6 % on average between 1990 and 2000, respectively.

18.3.4. Potential Replicability of Exports (Size of Market)

The total energy consumption in the sector was 25.3 Mtoe in 2000. The total electricity consumption was 125,900 GWh in 2000.

The Buildings Table of the National Climate Change Secretariat of Canada estimated in its 1999 report “Foundation Paper on the Commercial/Institutional Sector in Canada” the total number of commercial/institutional buildings in Canada in 1998 to be around 430,000.

18.3.5. Energy Efficiency Policies

There is a variety of energy efficiency policies in place. Detailed information about these policies and programs can be found in:

Natural Resources Canada, Office of Energy Efficiency, “Improving Energy Performance in Canada,” 2002.

http://oee.nrcan.gc.ca/publications/infosource/PDFs/Report_to_Parliament.pdf

International Energy Agency, “Energy Policies of IEA Countries, Canada 2000 Review,” 2000. <http://www.iea.org/books/countries/2000/canada2000.pdf>

International Energy Agency, “Energy Efficiency Update Canada,” 2002.
<http://www.iea.org/pubs/newslett/eneeff/cn.pdf>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

18.3.6. Carbon Credits

In 1992, Canada signed the United Nations Framework Convention on Climate Change and on December 16, 2002 Canada ratified the Kyoto protocol. Under this protocol, Canada agreed to reduce greenhouse gas emissions to 6% below 1990 levels by 2012. This represents a 26% reduction from projected 2012 levels.

Opportunities for carbon credits for energy efficiency improvements will therefore be available. However, the value of carbon credits for energy efficiency improvements in the service sector will be limited, since most of the energy consumed in the service sector is in form of low carbon fuels, namely natural gas (at 46% in 2000) and electricity (at 43% in 2000). Electricity in Canada was generated from 60% hydro, 19% coal, 13% nuclear, 5% natural gas, 3% petroleum, and 1% renewables in 1999.

Canada's total carbon dioxide emissions per GDP were 570 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is about the average on an international comparison.

18.3.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 4,578

18.3.8. Risk

Political risk: 2
Economic risk: 2
Legal risk: 1
Tax risk: 1
Operational risk: 2
Security risk: 1

Overall risk: 1.67
Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

18.4 Republic of Korea

18.4.1 Energy Efficiency Status

Final energy consumption in Korea's commercial and public service sector was growing very strongly at 19 % per year between 1989 and 1999. It decreased sharply during the 1997-1998 Asian economic crisis, followed by a strong recovery in 1999. The Korean commercial and public service sector uses mainly kerosene and electricity to meet its energy demand. The ratio of the fuels used remained more or less unchanged over the last decade; in 1999 kerosene use accounted for 37%, oil for 14 %, liquefied petroleum gases (LPG) for 14 %, electricity for 26 %, and natural gas for 8% (IEA, Energy Balances).

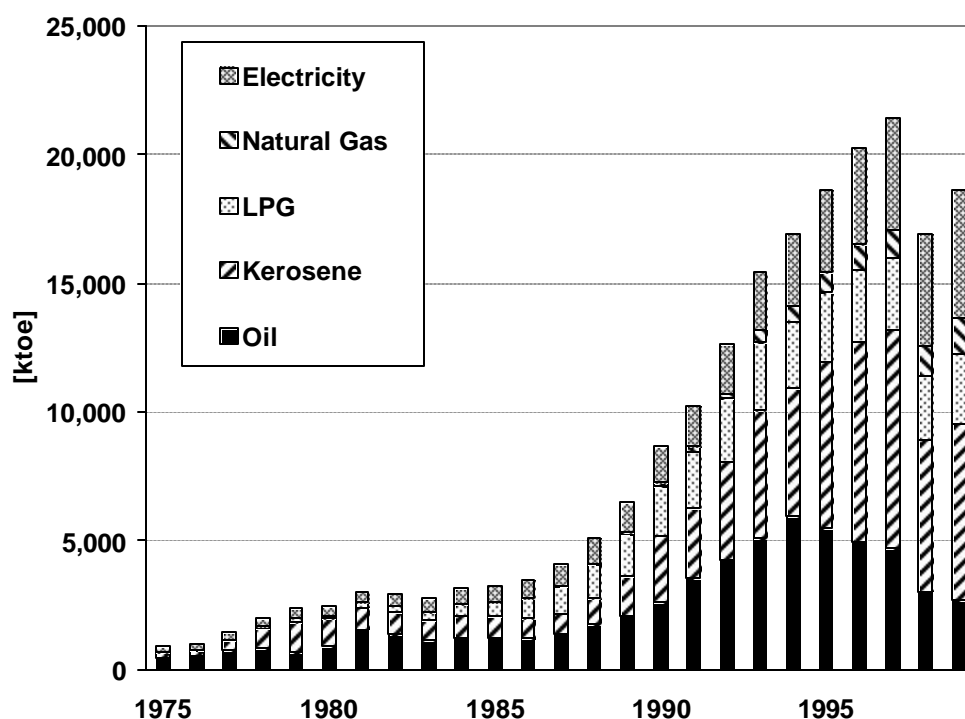


Fig. 18.4.1: Final energy consumption by source in the commercial and public service sector of Korea (Source: IEA, Energy Balances of OECD Countries, 2001).

The energy intensity of Korea's commercial and public service sector increased significantly in the last decades (except for a temporary decline after the Asian economic crisis in 1997). This is due to Korea's strong economic development (the activity effect) and the increasing energy consumption per worker in the service sector as a result of rising living standards (the intensity effect). The level of output per worker (the productivity effect) remained more or less constant in the last decade. The following figure analyzes the energy consumption trend in Korea's service sector as a function of economic activity ("Activity effect"), energy use per worker ("Intensity effect"), and the output produced by each worker ("Productivity effect"). The intensity effect is the most important driver of energy consumption, closely followed by the activity effect.

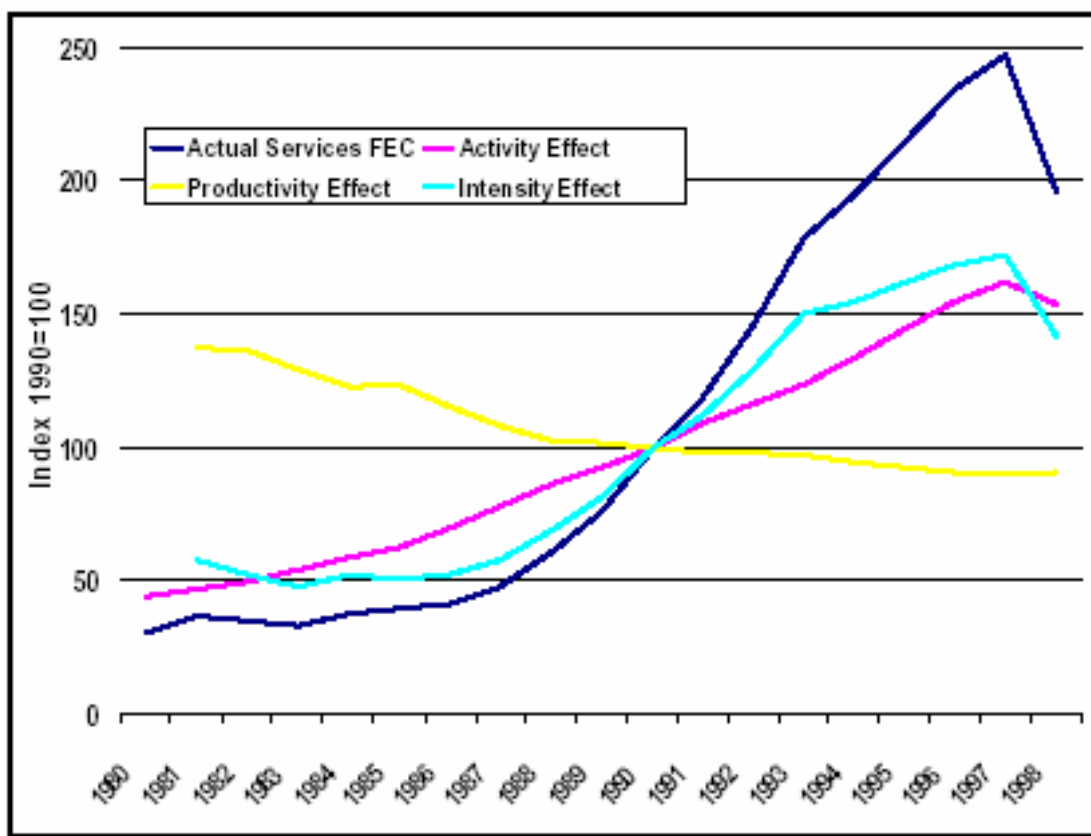


Fig. 18.4.2: Energy Consumption Decomposition Results for Korea's Service Sector

$$E = A \cdot \left(\frac{W}{A} \right) \cdot \left(\frac{E}{W} \right)$$

- with
- E ... final energy consumption (FEC) in the service sector
 - A ... economic activity (value added in the service sector in US \$ using PPPs) ("Activity effect")
 - W ... employment in the service sector
 - W/A ... labor productivity ("Productivity effect")
 - E/W ... energy intensity ("Intensity effect")

Source: Asia Pacific Energy Research Centre, "Energy Efficiency Indicators, A Study of Energy Efficiency Indicators in APEC Economies," March 2001.

The energy intensity in Korea's commercial and public service sector is comparable to other industrialized countries. However, one important difference is that Korea's energy intensity is likely to increase further, whereas the energy intensity of other developed nations is in general decreasing. This difference can be explained because Korea is still in an earlier stage of economic development compared with other industrialized countries.

Nevertheless, there is a high energy savings potential in Korea's service sector. The Korean Council on Energy and Environment estimated potential energy savings in Korea's residential and commercial sector of 35 % up to 2020.

The following table compares energy and electricity intensities in the commercial and public service sectors of Korea with the US and Japan in 1999.

	Korea	USA	Japan
Energy use [toe] per value added [mill 1995 US\$ PPP]	52	33	22
Energy use [koe] per employee	1,289	1,718	1,031
Energy use [koe] per floor space [m ²]		23.1	26.9
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	159	196	123
Electricity use [kWh] per employee	3,943	10,180	5,818
Electricity use [kWh] per floor space [m ²]		149	152

Tab. 18.4.1: Energy and electricity intensities in the commercial and public service sector in Korea (Rep.), USA, and Japan in 1999.

Sources: International Energy Agency, World Bank, US Department of Energy, ODYSSEE.

18.4.2 Price of Electricity

Electricity price for customers in the commercial and public service sector in December 2002:

102.66 KRW/kWh = 0.0859 US\$/kWh

Source: Korea Electric Power Corporation

18.4.3 Growth Rate of Electricity Consumption

The electricity consumption in the commercial and public service sector grew annually by 10.3 % on average between 1994 and 1999.

18.4.4 Potential Replicability of Exports (Size of Market)

The total electricity consumption was 57,243 GWh in 1999.

18.4.5 Energy Efficiency Policies

The legal basis for Korea's governmental energy efficiency policy is the Rational Energy Utilization Act. Under this act the Korean Energy Management Corporation (KEMCO) was established in 1980. It is a non-profit government agency responsible for funding and implementing energy conservation policies. In 2000, \$450 million were disbursed for that purpose. There are a variety of energy efficiency policies in place:

- Energy efficiency labeling and standards programs
- Minimum energy efficiency performance standards for certain appliances such as fluorescent lamps or heat-recovery ventilators
- Peak load management programs by a flexible rate system
- Insulating buildings and monitoring the energy use in buildings with high energy consumption

Further information can be found in:

International Energy Agency, "Energy Policies of IEA Countries, The Republic of Korea 2002 Review"

International Energy Agency, "Energy Efficiency Update for the Republic of Korea," 2002. <<http://www.iea.org/pubs/newslett/eneeff/co.pdf>>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

18.4.6 Carbon Credits

Korea signed the UN Framework Convention on Climate Change (UN FCCC) in June 1992 and ratified it on December 14, 1993. Korea signed the Kyoto Protocol on September 25, 1998 and ratified it on November 8, 2002. Currently, Korea is not a member of Annex I Parties to the UN FCCC. Consequently, it is not obliged to reduce its GHG emissions under the Kyoto Protocol. Korea considers itself a developing country with a need for continued economic growth and increasing energy consumption to support that growth.

However, as a member of the UN FCCC, the Republic of Korea has participated actively in the successive Conferences of the Parties. It took part in the Asia Least-cost Greenhouse Gas Abatement (ALGAS) project conducted with other Asian countries under the auspices of the Asian Development Bank and UNDP-GEF. Korea seeks to become a potential partner for Clean Development Mechanism projects. It is also active internationally and domestically in assessing the potential benefits of its participation in greenhouse gas emissions trading.

Korea's total carbon dioxide emissions per GDP were 639 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is about the average on an international comparison.

18.4.7 Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 2,788

18.4.8 Risk

Political risk:	4
Economic risk:	3
Legal risk:	2
Tax risk:	3
Operational risk:	4
Security risk:	2

Overall risk: 3.19

Overall risk rating: Moderate

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

18.5 Norway

18.5.1. Energy Efficiency Status

In 1999, electricity accounted for 82% of the final energy consumption in the service sector (IEA Energy Balances, 2001). The electricity intensity in the service sector, either defined as electricity consumption per value added or per floor space or per employee, is very high (see Tab. 18.5.1). The main reason for the high electricity intensity in the Norwegian service sector is the widespread use of electricity for space heating in service buildings (more than 80% of commercial space uses some form of electrical heating). The predominant use of electricity for space heating is not surprising, considering the vast Norwegian hydroelectric resources for inexpensive electricity. In addition, the cold climate and the very high living standard in Norway lead to a very high heating demand. Besides, very high lighting levels in businesses, reflecting the long and dark winters, enhance the electricity demand further. This explains why Norway has the highest per capita electricity consumption in the world.

The high electricity intensity in Norway can, therefore, mainly be attributed to inexpensive and abundant hydroelectric resources, very high space heating and lighting demand, which is predominately met by electricity, and the very high living standard.

The high electricity intensity is not caused by technological inefficiency. Norway has one of the highest comfort levels of space heating in Europe with nearly the lowest use of energy (net of combustion losses) relative to heated area and weather intensity (IEA 1997).

The following table compares energy and electricity intensities in the commercial and public service sectors of Norway with the US and Japan in 1999.

	Norway	USA	Japan
Energy use [toe] per value added [mill 1995 US\$ PPP]	36	33	22
Energy use [koe] per employee	1,366	1,718	1,031
Energy use [koe] per floor space [m ²]	22.4	23.1	26.9
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	348	196	123
Electricity use [kWh] per employee	13,032	10,180	5,818
Electricity use [kWh] per floor space [m ²]	222	149	152

Tab. 18.5.1: Energy and electricity intensities in the commercial and public service sector in Norway, USA, and Japan in 1999.

Sources: International Energy Agency, World Bank, US Department of Energy, ODYSSEE.

18.5.2. Price of Electricity

In the first quarter of 2003, the average price paid for electricity by services was 39.4 øre/kWh (=0.056 US\$/kWh), taxes excluded.

Source: Statistics Norway (<http://www.ssb.no>)

A more detailed breakdown for electricity and other energy carrier prices in the Norwegian service sectors 50-55 (Wholesale and retail trade; hotels and restaurants) for 2000 is given in the following table:

	Total	Total (except for gasoline and auto diesel)	Electricity (grid rent included)	District heating	Kerosene	Gasoline	Auto diesel, obliged by taxes	Auto diesel, not obliged by taxes	Heating oils	Fluid propane and butane	Other energy
Total	43,4	38,0	37,8	38,7	41,8	99,6	78,7	45,4	35,0	96,6	38,4
50 Sale, maintenance and repair of motor vehicles, motorcycles; retail sale of automotive fuel	45,8	37,8	38,1	39,9	42,3	99,2	79,8	43,3	35,2	98,8	..
50.1 Sale of motor vehicles	51,6	37,4	37,6	39,4	..	99,3	79,7	43,0	34,8	73,6	..
50.2 Maintenance and repair of motor vehicles	45,0	37,7	38,1	40,0	44,9	98,6	79,3	43,2	35,1	105,0	..
50.3 Sale of motor vehicles parts and accessories	44,4	38,5	38,4	41,7	41,4	102,5	82,0	43,9	36,5	90,1	..
50.4 Sale, maintenance and repair of motorcycles and related parts and accessories	40,5	38,8	38,8	..	..	99,1	75,6	..	35,0	..	..
50.5 Retail sale of automotive fuel	40,0	38,3	38,6	..	31,8	99,7	78,8	43,5	35,4	105,2	..
51 Wholesale trade and commission trade, except of motor vehicles and motorcycles	49,8	37,8	37,7	39,4	45,2	99,8	78,2	45,9	34,8	88,1	38,4
51.1 Wholesale on a fee or contract basis	52,5	38,0	38,2	38,6	72,1	99,3	79,3	45,6	35,2	..	..
51.2 Wholesale of agricultural raw materials and live animals	40,6	36,4	35,3	39,5	..	101,0	80,9	57,3	34,7	83,8	..
51.3 Wholesale of food, beverages and tobacco	58,6	37,2	37,2	38,3	0,0	100,0	77,3	41,5	34,9	100,7	38,4
51.4 Wholesale of household goods	50,1	37,3	37,2	41,1	50,8	100,3	82,0	67,6	34,4	193,2	..
51.5 Wholesale of non-agricultural intermediate products, waste and scrap	46,8	38,5	38,2	39,8	41,3	99,8	77,9	45,4	35,3	90,4	..
51.6 Wholesale of machinery, equipment and supplies	50,0	37,9	38,0	37,6	0,0	99,5	80,4	45,9	34,9	119,1	..
51.7 Other wholesale	44,7	36,8	37,7	..	..	98,6	72,9	..	33,9	..	..
52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	39,9	37,9	37,9	37,3	41,2	99,7	79,5	46,2	35,0	96,0	38,4
52.1 Retail sale in non-specialized stores	38,4	37,8	37,7	36,9	41,9	99,7	80,0	44,1	35,1	95,9	38,4
52.2 Retail sale of food, beverages and tobacco in specialized stores	43,3	41,1	41,1	..	..	97,9	79,2	..	34,8	105,0	..
52.3 Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles	41,8	38,7	38,7	..	..	99,3	81,5	45,0	36,0	..	..
52.4 Other retail sale of new goods in specialized stores	42,3	38,0	38,1	38,4	41,2	99,5	78,1	47,7	34,9	96,0	38,4
52.5 Retail sale of second-hand goods in stores	51,6	37,8	37,4	..	40,3	99,9	76,6	..	..	..	38,4
52.6 Retail sale not in stores	61,5	37,7	37,9	..	..	102,0	82,8	30,3	22,1	..	..
52.7 Repair of personal and household goods	56,2	38,2	38,3	..	..	100,2	84,8	..	35,5	..	..
55 Hotels and restaurants	40,4	38,4	37,5	36,3	41,5	99,8	79,2	39,1	34,7	99,4	38,4
55.1 Hotels	37,0	36,8	36,7	36,2	41,4	96,9	72,0	32,3	34,2	75,8	38,4
55.3 Restaurants	40,2	40,1	38,3	38,3	42,0	99,0	81,1	50,2	36,4	104,5	38,4
55.5 Canteens and catering	56,1	38,7	38,5	..	..	100,0	80,0	51,0	36,2	114,7	..

Tab. 18.5.1: Price of energy goods (not included in rent/common costs) for enterprises, by industry. 2000. Prices are inclusive of all taxes except for value added tax.

Unit: Øre/kWh

Source: Statistics Norway (<http://www.ssb.no>)

Note: Average exchange rate for 2000: 100 Øre = 1 NOK = 0.11395 US\$

18.5.3. Growth Rate of Electricity Consumption

The electricity consumption grew by 3.8% on average between 1994 and 1999.

18.5.4. Potential Replicability of Exports (Size of Market)

The total electricity consumption was 22,039 GWh in 1999.

18.5.5. Energy Efficiency Policies

A variety of energy efficiency policies are in place:

- 1999 White Paper on Energy Policy.
- 2001 and 2002 White Papers on Climate Change Policy.
- CO₂ taxes on various fuels were introduced in 1991.
- A broad-based domestic greenhouse gas emission trading system covering about 80% of the Norwegian emissions will be introduced for the Kyoto-period 2008-2012. The trading system will be compatible with the international trading system under the Kyoto protocol.
- State funds allocated for energy efficiency measures of NOK 347.2 mill (= US\$ 38.5 mill) in 2001.
- Establishment of Regional Energy Efficiency Centers in each of the 19 Norwegian counties in 1999. Utilities could collect a surcharge of 0.003 NOK/kWh (~ 0.0004 US\$/kWh) on transmission tariffs to finance energy efficiency measures carried out through these centers.
- Creation of a new public agency, Enova, in Trondheim. Enova started its operation in January 2002. It is responsible for funding energy efficiency and renewable energy projects. Funding mainly comes from a fee on electricity distribution tariffs. Approximately NOK 5 billion (~ US\$ 680 mill) are available for a ten-year period starting in 2002.
- New building codes became effective in 1997. The U-values for heated areas are (W/m²K): 0.22 for walls, 0.15 for roofs and floors, 1.6 for windows and doors.
- Establishment of the Energy Efficiency Network for Buildings (EENB) in 1996. The network provides information about energy efficiency projects completed in various Norwegian buildings.

- The Norwegian Government Environmental Fund is a loan scheme that provides funding for energy efficiency investments and other projects that helps to reduce greenhouse gas emissions.

Further information about energy efficiency policies in Norway can be found in:

- Energy Efficiency in Norway 1990-1999. A report based on the ODYSSEE database on energy efficiency indicators and the MURE database on energy efficiency policy measures with support from SAVE. http://www.ife.no/media/855_Odyssee-raport.pdf
- International Energy Agency: Energy Policies of IEA Countries. Norway 2001 Review. <http://www.iea.org/books/countries/2001/Norway.pdf>
- International Energy Agency: Energy Efficiency Update for Norway <http://www.iea.org/pubs/newslett/eneeff/no.pdf>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

18.5.6. Carbon Credits

Norway ratified the Framework Convention on Climate Change in July 1993 and signed the Kyoto Protocol in April 1998. The Norwegian commitment in the protocol is to limit the increase in greenhouse gas emissions to 1% between 1990 and the first commitment period from 2008 to 2012. Opportunities for carbon credits for energy efficiency improvements will therefore – at least theoretically - be available. However, the value of carbon credits for energy efficiency improvements in the service sector will be very small, since 82% of the energy consumed in the service sector is in form of electricity, which is by 99% generated from hydroelectric sources and, therefore, extremely clean.

Norway's total carbon dioxide emissions per GDP were 312 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is very low on an international comparison.

18.5.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 7,125

18.5.8. Risk

Political risk:	2
Economic risk:	2
Legal risk:	1
Tax risk:	3
Operational risk:	2
Security risk:	1

Overall risk: 2.00

Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

18.6 Singapore

18.6.1 Energy Efficiency Status

Singapore has a low energy intensity but relatively high electricity intensity in its commercial and public service sector (see Tab. 18.6.1). In 1999, 100 % of energy use in the commercial and public service sector was in form of electricity (IEA Energy Balances). The high electricity intensity is mainly due to the fact that all energy in the service sector is consumed as electricity and that Singapore's tropical location requires all year round air-conditioning to cool its office buildings. Another big source of electricity consumption is refrigeration. The Inter-Agency Committee on Energy Efficiency (IACEE), which was formed in 1997 by the Ministry of National Development, stated in its 2000 report (IACEE, 2000) on energy efficiency in Singapore that 33% of electricity in the building sector is used for air-conditioning and 25% for refrigeration. The same report states that the status of energy efficiency could be improved. According to the report, many Singapore buildings are over-cooled to the extent that occupants have to put on warm clothing, inefficient incandescent lamps are still widely used, and "super" windows that cut out heat while letting in the light are rare and expensive due to a lack of familiarity and an absence of a local market. The report mentions district cooling systems as a promising solution to reduce energy consumption and at the same time gain office space. Two district cooling systems are currently under development in Singapore.

Singapore's overall electricity consumption is expected to increase from 25,858 GWh in 1998 to 41,017 GWh in 2007 (IACEE, 2000). This represents an annual increase of 5.3%.

The following table compares energy and electricity intensities in the commercial and public service sectors of Singapore with the US and Japan in 1999.

	Singapore	USA	Japan
Energy use [toe] per value added [mill 1995 US\$ PPP]	14	33	22
Energy use [koe] per employee	545	1,718	1,031
Energy use [koe] per floor space [m ²]	19.9	23.1	26.9
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	163	196	123
Electricity use [kWh] per employee	6,338	10,180	5,818
Electricity use [kWh] per floor space [m ²]	231	149	152

Tab. 18.6.1: Energy and electricity intensities in the commercial and public service sector in Singapore, USA, and Japan in 1999.

Sources: International Energy Agency, World Bank, US Department of Energy, Eang (2001)

18.6.2 Price of Electricity

Electricity price for commercial customers in 1998 were 0.08 US\$/kWh (UNESCAP, 2001).

Note: Electricity prices are expected to change since Singapore's electricity market is currently being restructured.

18.6.3 Growth Rate of Electricity Consumption

The electricity consumption in the commercial and public service sector grew annually by 11.6 % on average between 1994 and 1999 (IEA Energy Balances).

The electricity consumption is expected to grow by 5.3% on average between 1998 and 2007 (IACEE, 2000).

18.6.4 Potential Replicability of Exports (Size of Market)

There were 511 office and office cum retail buildings in Singapore in 1998 (Eang, 2001).

The electricity consumption in Singapore's commercial and public service sector was 8,885 GWh in 1999 (IEA, Energy Balances).

18.6.5 Energy Efficiency Policies

The Singapore electricity industry is currently being restructured to implement a competitive electricity market structure. Energy conservation and efficiency has been actively promoted and pursued at a national level through a series of fiscal and non-fiscal policies with the objective of improving overall system efficiency through better load management. The Public Utilities Board of Singapore provides advisory services in efficient use of electricity to consumers in the industrial and commercial sectors. A set of energy conservation standards for building design has been incorporated into the Building Regulations administered by the Building and Construction Authority. A multi-agency committee is continuously looking into ways to increase energy efficiency and conservation in various areas.

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

18.6.6 Carbon Credits

Singapore signed the United Nations Framework Convention on Climate Change on June 13, 1992 and ratified it on May 29, 1997. However, Singapore did not sign or ratify the Kyoto protocol. Therefore, it cannot be the host country for a project activity under the Clean Development Mechanism (CDM) of the Kyoto Protocol until it signs and ratifies the protocol.

Singapore's total carbon dioxide emissions per GDP were 662 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is about the average on an international comparison.

For more information see <<http://unfccc.int/resource/docs/natc/sinncl.pdf>>.

18.6.7 Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 6,794

18.6.8 Risk

Political risk:	2
Economic risk:	2
Legal risk:	1
Tax risk:	1
Operational risk:	1
Security risk:	2

Overall risk: 1.67

Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

18.7 United States (for comparison only)

The following table lists energy and electricity intensities in the commercial and public service sectors of the US in 1999.

	USA
Energy use [toe] per value added [mill 1995 US\$ PPP]	33
Energy use [koe] per employee	1,718
Energy use [koe] per floor space [m ²]	23.1
Electricity use [kWh] per value added [thousands 1995 US\$ PPP]	196
Electricity use [kWh] per employee	10,180
Electricity use [kWh] per floor space [m ²]	149

Tab. 18.7.1: Energy and electricity intensities in the commercial and public service sector in the USA in 1999.

Sources: International Energy Agency, World Bank, US Department of Energy.

19. Country Notes for Priority Markets in the Manufacturing Sector

In this chapter, some of the most promising markets for the export of energy efficiency products for the manufacturing sector, that were identified in the analysis of manufacturing sectors in part I of this work and by the screening analysis in part II of this work and where necessary data was available, will be analyzed in more detail.

It should be noted that the selection of the countries covered in this chapter is not only based on their energy efficiency potential but more a result of data availability. There are certainly more than the five countries listed below with promising opportunities for energy efficiency investments. Even countries that show a low ranking in table 5.5 may have significant potential in certain industrial sectors or sub-sectors.

The analyzed markets are:

Australia
Bulgaria
Canada
Norway
Thailand

US (for comparison only)

19.1 Summary (Comparison of the Target Markets):

Country	Manufacturing Sector	Energy Intensity (Sectoral energy intensity relative to energy intensity of comparable US sector)	Price of electricity [US cents / kWh]	Growth Rate of Energy Use 1994 to 1999	Market Size (Number of establishments)*	Energy Efficiency Policies in Place	Carbon Credits (Total CO ₂ emissions per GDP [g CO ₂ / US\$ PPP])	Financing (Gross fixed capital formation per capita in 2000 [current US\$])	Risk (1 ... 9) (1 = min., 9 = max.)
Australia	Food	2.0	3.3	1.5 %		Many	771	4,269	1.88
	Non-ferrous metals	3.0							
	Iron and steel	1.5							
	Chemicals	1.3							
	Non-metallic minerals	1.1							
Bulgaria	Food	2.0	3.3	- 7.1 %	6,423	Few	877	242	4.53
	Chemicals	9.8			496				
	Non-metallic minerals	4.1			799				
	Machinery	2.2			5,076				
	Transport equipment	1.8			482				
Canada	Leather	2.3	3.9 – 4.9	1.3 %	176	Many	570	4,578	1.67
	Paper	2.0			663				
	Non-metallic minerals	1.8			1,354				
	Non-ferrous metals	2.0							
Norway	Food	2.0	1.9	1.2 %	1,658	Many	312	7,125	2.00
	Paper and pulp	1.5			98				
	Chemicals	2.7			200				
	Non-metallic minerals	2.4			600				
	Iron and steel	7.7							
	Non-ferrous metals	5.2							
Thailand	Food	10.1	5.6	3.1 %	3,102	Some	565	438	4.10
	Textile and Leather	2.5			3,695				
	Non-metallic minerals	4.6			1,802				

*Note: Different industrial classification systems used. See explanations in chapters 19.1 – 19.6.

Rating of Target Markets in Terms of Export Opportunities for Energy-efficiency Technologies:

Country	Manufacturing Sector	Energy Intensity	Cost of Energy	Growth Rate of Energy Use	Market Size	Energy Efficiency Policies	Carbon Credits	Financing	Risk
Australia	Food	*****	***	***		*****	*****	****	*****
	Non-ferrous metals	*****							
	Iron and steel	***							
	Chemicals	**							
	Non-metallic minerals	**							
Bulgaria	Food	*****	***	*	*****	**	*****	*	**
	Chemicals	*****			*****				
	Non-metallic minerals	*****			**				
	Machinery	*****			*****				
	Transport equipment	****			**				
Canada	Leather	*****	*****	***	***	*****	***	****	*****
	Paper	****			****				
	Non-metallic minerals	****			****				
	Non-ferrous metals	*****							
Norway	Food	*****	*	***	***	*****	*	*****	*****
	Paper and pulp	**			*				
	Chemicals	*****			***				
	Non-metallic minerals	*****			***				
	Iron and steel	*****							
	Non-ferrous metals	*****							
Thailand	Food	*****	*****	*****	****	***	***	*	***
	Textile and Leather	*****			****				
	Non-metallic minerals	*****			*****				

***** Very favorable

**** Favorable

*** Medium

** Unfavorable

* Very unfavorable

Rating system used:

Rating	Energy Intensity (Sectoral energy intensity relative to energy intensity of comparable US sector)	Price of electricity [US cents / kWh]	Growth Rate [%] of Energy Use 1994 to 1999	Market Size (Number of establishments)	Energy Efficiency Policies in Place	Carbon Credits (Total CO ₂ emissions per GDP [g CO ₂ / US\$ PPP])	Financing (Gross fixed capital formation per capita in 2000 [current US\$])	Risk (1 ... 9) (1 = min., 9 = max.)
*****	> 2.00	> 5.0	> 2.00	See below	Many	> 700	> 5,000	= 2.50
****	1.51 ... 2.00	4.1 ... 5.0	1.51 ... 2.00	See below	Several	601 ... 700	2,001 ... 5,000	2.51 ... 3.50
***	1.01 ... 1.50	3.1 ... 4.0	1.01 ... 1.50	See below	Some	501 ... 600	1,001 ... 2,000	3.51 ... 4.50
**	0.51 ... 1.00	2.1 ... 3.0	0.51 ... 1.00	See below	Few	401 ... 500	501 ... 1,000	4.51 ... 5.50
*	= 0.50	= 2.0	= 0.50	See below	None	= 400	= 500	> 5.50

Rating	Market Size (Number of establishments)							
	Food	Textiles (including leather)	Leather	Paper	Chemicals	Non-metallic minerals	Machinery	Transport equipment
*****	> 5,000	> 5,000	> 500	> 750	> 350	> 1,500	> 5,000	> 750
****	3,001 ... 5,000	3,001 ... 5,000	301 ... 500	501 ... 750	251 ... 350	1,001 ... 1,500	2,001 ... 5,000	501 ... 750
***	1,501 ... 3,000	1,501 ... 3,000	151 ... 300	301 ... 500	151 ... 250	501 ... 1,000	1,001 ... 2,000	301 ... 500
**	501 ... 1,500	501 ... 1,500	51 ... 150	101 ... 300	51 ... 150	101 ... 500	501 ... 1,000	101 ... 300
*	= 500	= 500	= 50	= 100	= 50	= 100	= 500	= 100

19.2 Australia

19.2.1. Energy Efficiency Status

As seen in Tab. 5.5 for the total manufacturing sector, Australia's energy intensity is relatively high. This is mainly due to the high share of energy intensive raw materials in Australian manufacturing production, particularly the production of ferrous and non-ferrous metals. However, even after a structural adjustment of Australia's manufacturing sector to the structure of the average OECD-13 manufacturing industry structure, Australia's overall energy intensity remains the third highest among the thirteen biggest OECD economies (see Fig. 5.1). One explanation for this may be lower energy efficiency, but it could also be structural differences within the energy intensive manufacturing sectors compared to other countries. The latter interpretation is supported by the fact that Australia's non-ferrous metal sector is dominated by very energy-intensive aluminum and alumina production. To get a clear picture of energy efficiency in Australia energy intensive sectors, further disaggregation is necessary, which is, however, beyond the scope of this work.

Schipper and al. (2001) compared the energy intensities of selected manufacturing sectors in Australia, Canada, Norway, Japan, US, France, and UK in 1994 (see Fig. 19.2.1).

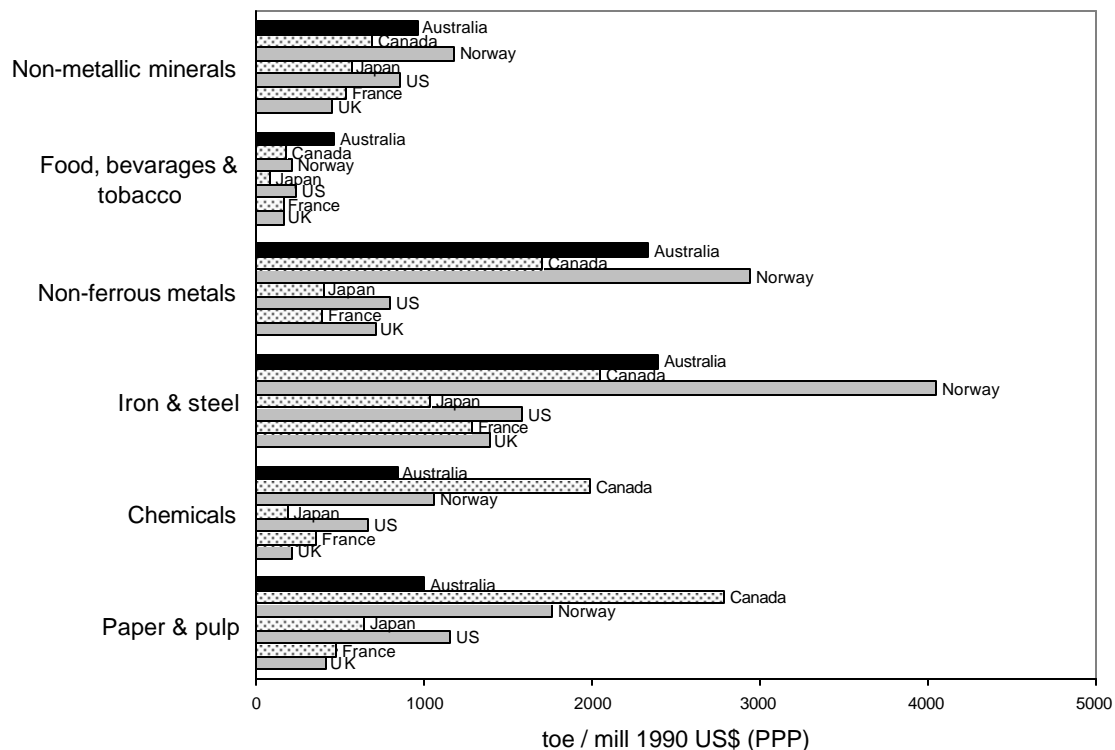


Fig. 19.2.1. Energy intensities of selected manufacturing sectors (according to ISIC Rev. 2) in 1994 in Australia, Canada, Norway, Japan, US, France, and UK.

Source: Schipper et al. (2001)

From Fig. 19.2.1 one can see that Australia has a high energy intensity compared to other industrialized countries in the following sectors:

- **Food and tobacco**
- **Non-ferrous metals**
- **Iron and steel**
- **Chemicals**
- **Non-metallic minerals**

An important factor behind the high energy intensity of the Australian food sector is the low energy efficiency in Australia's sugar mills (Schipper et al., 2001).

Australia's energy intensity (at constant structure of the manufacturing sector) declined by only 18% between 1973 and 1994. This is significantly lower than the energy intensity decrease in other OECD countries (see Fig. 19.2.2). For example, energy intensity (at constant industry structure) decreased by 42% in the UK, by 39% in Japan, and by 37% in France, in the same time period.

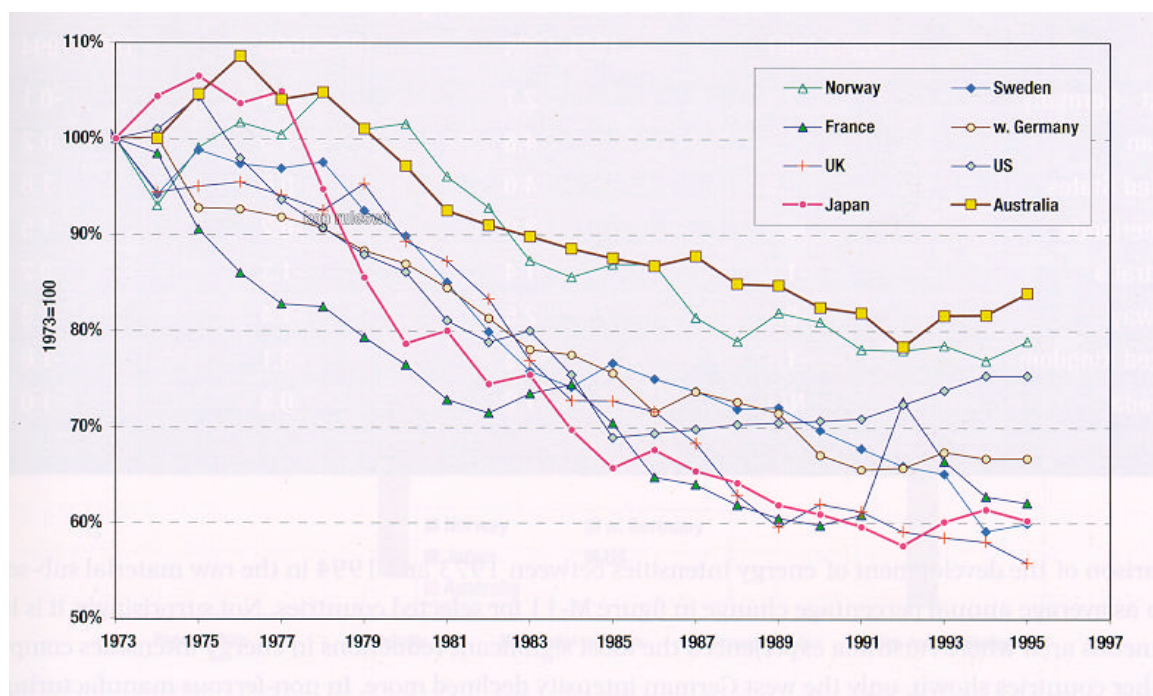


Fig. 19.2.2: Change in manufacturing energy intensity at constant structure

Source: Schipper et al, 2001

19.2.2. Price of Energy

Price for electricity for industrial customers in 2001:
AUD 0.064 / kWh = US\$ 0.033 / kWh

Source: Electricity Supply Association of Australia.

19.2.3. Growth Rate of Energy Consumption

The energy consumption grew by 1.5% on average between 1994 and 1999.

19.2.4. Potential Replicability of Exports (Size of Market)

The total energy consumption in the whole manufacturing sector was 20,963 ktoe in 1999.

The following table gives data about turnover and value added by manufacturing sector.

Industry subdivision	Turnover [millions AUD]	Value added [thousands AUD]
Food, beverage and tobacco	51,089	14,496
Textile and leather	9,337	3,058
Wood and paper product manufacturing	14,060	4,747
Printing, publishing and recorded media	17,256	7,238
Petroleum, coal and chemicals	36,002	9,953
Non-metallic minerals	10,560	3,650
Metals	41,304	10,809
Machinery	44,350	13,739
Other manufacturing	7,188	2,327
Total manufacturing	231,145	70,018

Tab. 19.2.1: Manufacturing statistics 1999-2000.

Source: Australian Bureau of Statistics

19.2.5. Energy Efficiency Policies

In recent years, the Australian government has undertaken a number of initiatives to encourage improvements in energy efficiency. These include:

- The Energy Efficiency Best Practice Program. The Australian government launched this program in mid-1998. The program is scheduled to run over a five-year period with government funding of AU\$ 10.3 million. It assists targeted industries to reduce their greenhouse gas emissions through improving energy efficiency, while also reducing costs and increasing productivity. Program activities include training, energy surveys and data collection; good practice guides and good-practice case studies.
- The Greenhouse Challenge program is a joint voluntary initiative between the Commonwealth government and industry in Australia to abate greenhouse gas emissions, but much of its activity focuses on energy-efficient technologies and processes. The Greenhouse Challenge program is open to large industrial firms. Smaller businesses can participate through another program called Greenhouse Allies. Under the Greenhouse Allies program, large Greenhouse Challenge members mentor smaller firms through a group process in order to help them reduce their emissions.
- Generator efficiency guidelines for new fossil-fuelled power plants, introduced in July 2000.

Further information can be found in:

- Deni Greene and Alan Pears, "Policy Options for Energy Efficiency in Australia," ACRE (The Australian CRC for Renewable Energy), January 2003.
<<http://www.acre.ee.unsw.edu.au/downloads/AEPG%20Energy%20Efficiency%20report%20-%202003.pdf>>
- International Energy Agency: Energy Policies of IEA Countries. Australia 2001 Review.
<<http://www.iea.org/books/countries/2001/australia.pdf>>
- International Energy Agency: Energy Efficiency Update for Australia
<<http://www.iea.org/pubs/newslett/eneeff/Au.pdf>>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

19.2.6. Carbon Credits

Australia's total carbon dioxide emissions per GDP were 771 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is high on an international comparison.

Australia's greenhouse gas emissions measured on a per capita basis are among the highest in the world. This is due to significant land clearing for agricultural activities, high vehicle usage due to long distances of travel, high proportion of coal use in electricity generation, and many energy intensive manufacturing industries. For this reason, the Australian government is active in supporting greenhouse emission mitigation through various programs and initiatives. Australia is also host of several organizations and businesses dealing with greenhouse gas emissions trading.

For these reasons, there are relative good opportunities for obtaining carbon credits for energy efficiency projects.

19.2.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 4,269

19.2.8. Risk

Political risk:	2
Economic risk:	2
Legal risk:	1
Tax risk:	2
Operational risk:	2
Security risk:	2

Overall risk: 1.88
Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

19.3 Bulgaria

19.3.1. Energy Efficiency Status

Energy efficiency in Bulgaria is extremely low, even compared with other Central and Eastern European countries in transition. This is a result of the rather slow progress in reforming and restructuring of the energy sector, remaining price distortions, and weak institutional capacity.

An additional problem for Bulgaria is its heavy dependence on energy imports (it has to import more than 70% of its primary energy sources, mainly from Russia, which amount to 27% of Bulgaria's foreign trade balance). The only significant domestic energy source is low-quality lignite coal with high sulfur content. Nearly half of Bulgaria's electricity is generated in Bulgaria's only nuclear power plant in Kozloduy containing six reactor units. Aiming to comply with Euratom nuclear safety requirements, Bulgaria agreed to close down Units 1 and 2 of Kozloduy by 2003, and Units 3 and 4 by 2006. Units 5 and 6 are being modernized using a Euratom loan.

Because of the constraints on the energy supply side and the huge inefficiencies on the demand side, and considering Bulgaria's goal to join the European Union by 2007 which is only possible by adopting the common rules, standards and policies that make up the body of EU law, Bulgaria is expected to put stronger efforts in improving its energy efficiency.

The following table compares energy intensities in manufacturing sectors in Bulgaria and the US.

Industry sector (ISIC Rev. 3)	Bulgaria	United States
Food and Tobacco	221	112
Textile and Leather	150	122 *
Wood and Wood Products	578	598
Paper, Pulp, and Printing	387	532 *
Chemical	6,922	705
Non-metallic Minerals	1,447	356
Iron and Steel		716
Non-ferrous Metals		558
Machinery	95	43
Transport Equipment	67	37

Tab. 19.3.1: Comparison of industrial energy intensity (energy use per value added) in Bulgaria and the US in 1999. Units: toe/mill 1995 US \$ PPP.

Source: UNIDO, International Energy Agency.

Notes:

* Energy intensity for US textile and paper, pulp, and printing sectors is from Tab. 19.1.1 and is for 1998 and these industry sectors are defined according to NAICS, which is not exactly the same as ISIC Rev.3.

From the table above one can see that Bulgaria has a much higher energy intensity compared to the USA in the following sectors:

- **Food and Tobacco**
- **Chemical**
- **Non-metallic minerals**
- **Machinery**
- **Transport equipment**

19.3.2. Price of Energy

Price of electricity for businesses in 2001 (without VAT):
 $0.072 \text{ BGL/kWh} = 0.033 \text{ US\$/kWh}$

Price of natural gas for all end users in 2001:
 $0.25692 \text{ BGL/Nm}^3 = 0.118 \text{ US\$/Nm}^3$

Note: It is expected that the existing practice of uniform prices for all categories of end users of natural gas will be discontinued in the near future.

19.3.3. Growth Rate of Energy Consumption

The energy consumption in the manufacturing sector fell by 7.1% annually on average between 1994 and 1999.

19.3.4. Potential Replicability of Exports (Size of Market)

The number of establishments (factories) and the sectoral energy consumption in 1999 was:

Industry sector (ISIC Rev. 3)	Number of establishments	Energy consumption [ktoe]
Food and Tobacco	6,423	326
Textile and Leather	4,120	132
Wood and Wood Products	1,934	49
Paper, Pulp, and Printing	1,538	99
Chemical	496	1,909
Non-metallic Minerals	799	506
Iron and Steel		
Non-ferrous Metals		
Machinery	5,076	145
Transport Equipment	482	16

19.3.5. Energy Efficiency Policies

Bulgaria is confronted with major challenges in its energy sector:

- Heavy dependence on energy imports (more than 70% of primary energy)
- Only significant domestic energy source is low-quality lignite coal with high sulfur content
- Four out of six units of Bulgaria's only nuclear reactor will be shut down
- Absence of market mechanisms in Bulgaria's energy sector
- Absence of an appropriate legal framework for the energy sector
- Distorted energy prices (particularly for the residential sector)
- Very weak regulatory and institutional framework
- Financial problems of energy companies operating on a commercial basis

In the last years, Bulgaria has intensified its efforts to reform its energy sector. The legislative framework has been aligned to enable an opening of the energy market. The Law on Energy and Energy Efficiency was amended in November 2001. Privatization of energy distribution companies is under preparation. A new national energy strategy was adopted by the Bulgarian parliament in July 2002. The strategy's goal is the introduction of market mechanisms and improvements in energy efficiency.

The State Energy Regulation Commission (SERC), which was created in 1999, is responsible for developing and implementing a market-based tariff and price-setting methodology. A Ministry of Energy and Energy Resources was created in December 2001, incorporating the State Energy Efficiency Agency (SEEA). However, SEEA is understaffed, having only 27 employees.

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	insufficient
Existence of an agency responsible for energy efficiency policies	yes (however, understaffed)
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	insufficient

19.3.6. Carbon Credits

Bulgaria ratified the UN Framework Convention on Climate Change in 1995 as Annex I party and ratified the Kyoto protocol in August 2002. Therefore, it can be a host country for a Joint Implementation project with another Annex I country, but cannot be a host country for a project under the Clean Development Mechanism. Bulgaria's commitment in the protocol is to reduce its greenhouse gas emissions by 8% from the level in 1990 by the first commitment period from 2008 to 2012. Due to the economic decline, greenhouse gas emissions decreased by 51% from the 1990 level in 1999 (see Fig. 19.3.1).

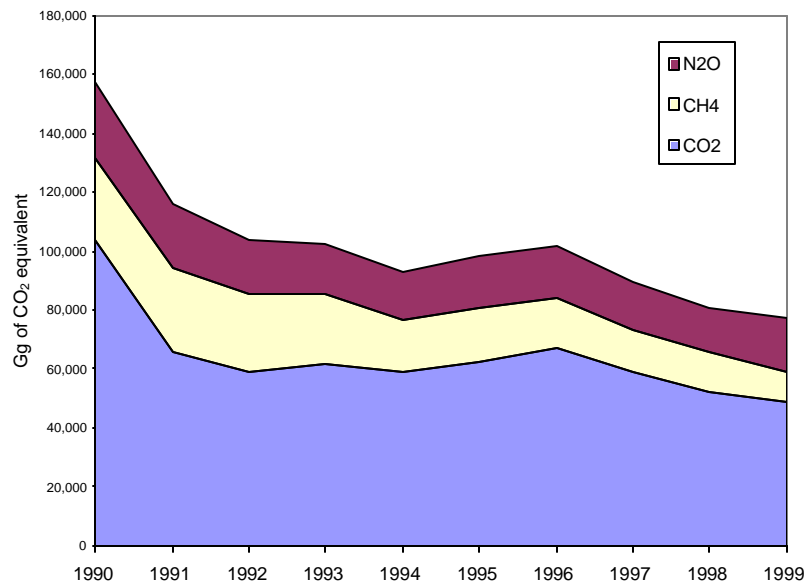


Fig. 19.3.1: Greenhouse gas emissions in Bulgaria (Source: UNFCCC)

Bulgaria's total carbon dioxide emissions per GDP were 877 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is very high on an international comparison.

19.3.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 242

19.3.8. Risk

Political risk:	4
Economic risk:	4
Legal risk:	5
Tax risk:	5
Operational risk:	5
Security risk:	5

Overall risk: 4.53

Overall risk rating: Medium

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

19.4 Canada

19.4.1. Energy Efficiency Status

According to the Report “Energy Efficiency Trends in Canada 1990 to 2000” of Natural Resources Canada, industrial energy use increased between 1990 and 2000 by 16 percent, or 448.9 PJ (Fig. 19.4.1 and 19.4.2). Without energy efficiency improvements (which accounted for 239.2 PJ in energy savings) and without structural changes (which accounted for 316.7 PJ in energy savings), energy use would have increased by 1,004.7 PJ in the same period (Fig. 19.4.1 and 19.4.2).

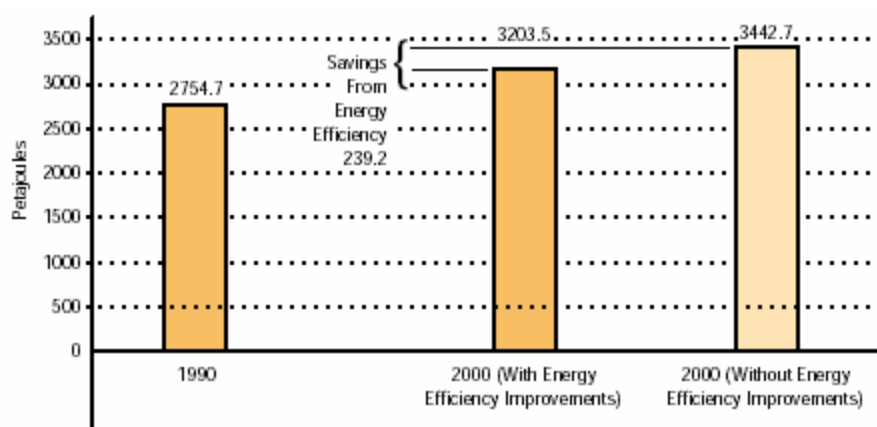


Fig. 19.4.1: Industrial energy use, with and without energy efficiency improvements

Source: “Energy Efficiency Trends in Canada 1990 to 2000,” Office of Energy Efficiency, Natural Resources Canada, 2002.

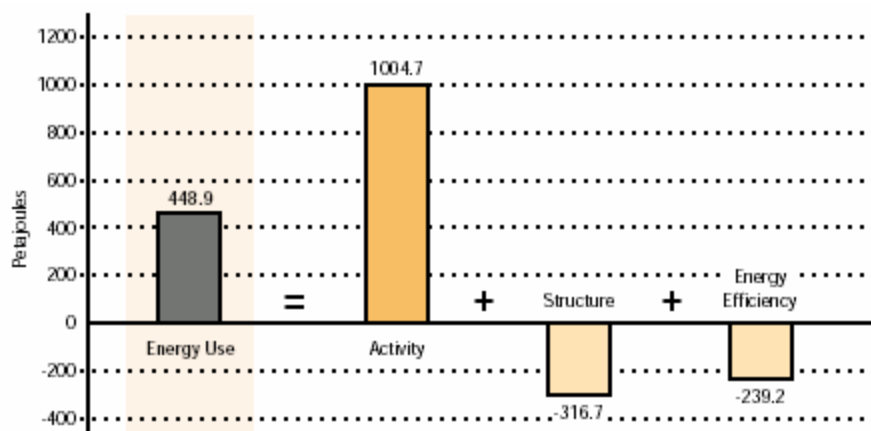


Fig. 19.4.2: Impact of economic activity changes, industry structure changes and energy efficiency improvements on the change in industrial energy use in Canada between 1990 and 2000.

Source: “Energy Efficiency Trends in Canada 1990 to 2000,” Office of Energy Efficiency, Natural Resources Canada, 2002.

The following two tables (Tab. 19.4.1 and 19.4.2) compare the energy intensities in the manufacturing sectors in Canada and the US:

Industry sector (ISIC Rev. 3)	Canada	United States
Food and Tobacco		112
Textile and Leather		122 *
Wood and Wood Products	37	598
Paper, Pulp, and Printing		532 *
Chemical	1,336	705
Non-metallic Minerals		356
Iron and Steel	832	716
Non-ferrous Metals	1,139	558
Machinery		43
Transport Equipment		37

Tab. 19.4.1: Comparison of industrial energy intensity (energy use per value added) in Canada and the US in 1999 broken down by ISIC sectors.

Units: toe/mill 1995 US \$ PPP.

Source: UNIDO, International Energy Agency.

*Note: Energy intensity for US textile and paper, pulp, and printing sectors is from Tab. 19.1.1 and is for 1998 and these industry sectors are defined according to NAICS, which is not exactly the same as ISIC.

NAICS sector	Description	Canada (1999)	USA (1998)
311	Food Manufacturing	150	150
312	Beverage and Tobacco Product Manufacturing	59	43
313	Textile Mills	187	268
314	Textile Product Mills	131	94
315	Clothing Manufacturing	42	38
316	Leather and Allied Product Manufacturing	91	40
321	Wood Product Manufacturing	174	368
322	Paper Manufacturing	1,879	938
323	Printing and Related Support Activities	48	40
324	Petroleum and Coal Products Manufacturing	3,862	5,757
325	Chemical Manufacturing	592	656
326	Plastics and Rubber Products Manufacturing	108	95
327	Non-Metallic Mineral Product Manufacturing	812	461
331	Primary Metal Manufacturing	1,201	922
332	Fabricated Metal Product Manufacturing	94	79
333	Machinery Manufacturing	34	38
334	Computer and Electronic Product Manufacturing	15	20
335	Electrical Equipment, Appliance and Component Manufacturing	55	60
336	Transportation Equipment Manufacturing	41	50
337	Furniture and Related Product Manufacturing	54	58

Tab. 19.4.2: Industrial energy intensity (energy consumption per value added) in Canada in 1999 and in the USA in 1998 broken down by NAICS sectors. Units: toe/mill 1995 US\$ PPP

Sources: CIEEDAC (2003), Industry Canada (<http://strategis.ic.gc.ca>)

From the tables above one can see that Canada has a higher energy intensity compared to the USA in the following sectors:

- **Leather and Allied Product Manufacturing (NAICS 316)**
- **Paper Manufacturing (NAICS 322)**
- **Non-metallic Mineral Product Manufacturing (NAICS 327)**
- **Non-ferrous Metals (ISIC 272 and 2732)**

More information about energy use, fuel mix used, production data, and energy intensity in these sectors, and their sub-sectors, can be found in CIEEDAC (2003).

19.4.2. Price of Energy

Prices for the industrial sector in 2001:

Electricity:	0.0394 ... 0.0491 US\$/kWh
Natural gas:	0.1745 US\$/m ³
Light Fuel Oil:	0.23 US\$/liter
Heavy Fuel Oil:	0.1738 US\$/liter

Source: Natural Resources Canada, Office of Energy Efficiency
< http://oee1.NRCan.gc.ca/neud/dpa/handbook_ind_ca.cfm>

19.4.3. Growth Rate of Energy Consumption

The energy consumption grew by 1.3% on average in Canada's manufacturing sector between 1994 and 1999.

19.4.4. Potential Replicability of Exports (Size of Market)

NAICS Sector	Description	Number of active establishments in 1999
311	Food Manufacturing	3,467
312	Beverage and Tobacco Product Manufacturing	227
313	Textile Mills	374
314	Textile Product Mills	422
315	Clothing Manufacturing	1,342
316	Leather and Allied Product Manufacturing	176
321	Wood Product Manufacturing	2,144
322	Paper Manufacturing	663
323	Printing and Related Support Activities	2,623
324	Petroleum and Coal Products Manufacturing	204
325	Chemical Manufacturing	1,274
326	Plastics and Rubber Products Manufacturing	1,436
327	Non-Metallic Mineral Product Manufacturing	1,354
331	Primary Metal Manufacturing	478
332	Fabricated Metal Product Manufacturing	4,283
333	Machinery Manufacturing	2,653
334	Computer and Electronic Product Manufacturing	956
335	Electrical Equipment, Appliance and Component Manufacturing	605
336	Transportation Equipment Manufacturing	1,332
337	Furniture and Related Product Manufacturing	1,748

Tab. 19.4.9: Number of active establishments in the Canadian manufacturing sector in 1999.

19.4.5. Energy Efficiency Policies

There is a variety of energy efficiency policies are in place. Detailed information about these policies and programs can be found in:

Natural Resources Canada, Office of Energy Efficiency, "Improving Energy Performance in Canada," 2002. http://oee.nrcan.gc.ca/publications/infosource/PDFs/Report_to_Parliament.pdf

International Energy Agency, "Energy Policies of IEA Countries, Canada 2000 Review," 2000. <http://www.iea.org/books/countries/2000/canada2000.pdf>

International Energy Agency, "Energy Efficiency Update Canada," 2002. <http://www.iea.org/pubs/newslett/eneeff/cn.pdf>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

19.4.6. Carbon Credits

In 1992, Canada signed the United Nations Framework Convention on Climate Change and on December 16, 2002 Canada ratified the Kyoto protocol. Under this protocol, Canada agreed to reduce greenhouse gas emissions to 6% below 1990 levels by 2012. This represents a 26% reduction from projected 2012 levels.

Opportunities for carbon credits for energy efficiency improvements will therefore be available. The value of carbon credits for energy efficiency improvements depends on the carbon content of the fuels used. Canada's industry uses mainly low carbon fuels (natural gas at 34%, combustible renewables and waste at 12%) and electricity at 25%, which is generated from 60% hydro, 19% coal, 13% nuclear, 5% natural gas, 3% petroleum, and 1% renewables (in 1999).

Canada's total carbon dioxide emissions per GDP were 570 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is about the average on an international comparison.

19.4.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 4,578

19.4.8. Risk

Political risk: 2
Economic risk: 2
Legal risk: 1
Tax risk: 1
Operational risk: 2
Security risk: 1

Overall risk: 1.67

Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

19.5 Norway

19.5.1. Energy Efficiency Status

The ODYSSEE study for Norway analyzed the change of energy use in the Norwegian manufacturing sector between 1990 and 1999. The study finds that the actual (observed) increase in energy consumption of about 13% (between 1990 and 1999) can be attributed to three different factors: an activity effect of about 18%, a structure effect of about -1%, and an energy intensity effect of about -3% (see Fig. 19.5.1).

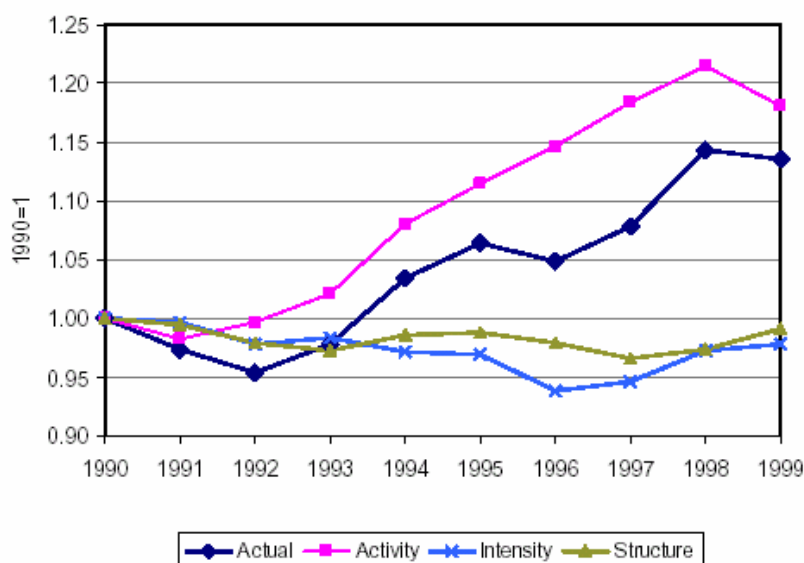


Fig. 19.5.1: Activity, structure, and intensity effect on energy consumption between 1990 to 1999. Source: ODYSSEE.

Note: The activity effect shows the influence of the economic activity on the energy use (keeping the industry structure and energy intensity constant at the 1990 level). The structure effect shows the influence of the structural changes within the industry sector on the energy use (keeping the economic activity and energy intensity constant at the 1990 level). The energy intensity effect shows the influence of energy intensity changes - and, therefore, inversely, energy efficiency changes - on the energy consumption (keeping the industry structure and the economic activity constant at the 1990 level).

Thus, pure energy intensity (at constant activity and structure) in the Norwegian manufacturing sector (ISIC divisions 15-37) declined about 3% from 1990 to 1999. However, the last years show an increasing intensity trend.

The following tables (Tab. 19.5.1.a and 19.5.1.b) list the energy intensities in various industrial sectors and sub-sectors.

Industry division (SIC 94)	Energy intensity (energy use [toe] per value added [mill current US\$ ex. rate]	Energy intensity (energy use [toe] per value added [mill 1995 US\$ PPP]
15-37 MANUFACTURING	421	765
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	124	226
15.1 Meat and meat products	137	250
15.2 Fish and fish products	263	478
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	126	229
17 Textiles	147	267
18 Wearing apparel, dressing and dyeing of fur	60	109
19 Leather and leather products	111	202
20 WOOD AND WOOD PRODUCTS	366	666
21 PULP, PAPER AND PAPER PRODUCTS	1795	3263
22 PUBLISHING AND PRINTING ETC.	30	55
23-24 REFINED PETROLEUM PRODUCTS AND CHEMICAL PRODUCTS	1112	2021
25 RUBBER AND PLASTIC PRODUCTS	157	285
26 OTHER NON-METALLIC MINERAL PRODUCTS	565	1028
27 BASIC METALS	1759	3197
28 METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	75	136
29 MACHINERY AND EQUIPMENT N.E.C	56	102
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	40	72
30 Office machinery and computers	27	49
31 Electrical machinery and apparatus n.e.c.	72	131
32 Radio, television, communication equipment and apparatus	17	32
33 Medical, precision and optical instruments	23	42
34-35(-35.114/5) TRANSPORT EQUIPMENT	71	130
34 Motor vehicles, trailers and semitrailers	129	234
35(-35.114/5) Other transport equipment	51	92
35.114/5 OIL PLATFORMS	27	48
36-37 MANUFACTURING N.E.C.	109	199
37 Recycling	217	395

Tab. 19.5.1.a: Industrial energy intensity in 2000. Source: Statistics Norway.

Note: Differences between this table and the tables for industrial energy intensities in chapters 6-15 are due to a different industry sector classification and different years analyzed.

Industry sector (ISIC Rev. 3)	Norway	United States
Food and Tobacco	226 *	112
Textile and Leather	142	122 **
Wood and Wood Products	612	598
Paper, Pulp, and Printing	798	532 **
Chemical	1,926	705
Non-metallic Minerals	863	356
Iron and Steel	5,474	716
Non-ferrous Metals	2,871	558
Machinery	59	43
Transport Equipment	56	37

Tab. 19.5.1.b: Comparison of industrial energy intensity (energy use per value added) in Norway and the US in 1999. Units: toe/mill 1995 US \$ PPP.

Notes:

*Energy intensity for Norwegian food sector is from Tab. 19.5.1.a and is for 2000 and the food sector is defined according to SIC94, which is not exactly the same as ISIC Rev.3.

** Energy intensity for US textile and paper, pulp, and printing sectors is from Tab. 19.1.1 and is for 1998 and these industry sectors are defined according to NAICS, which is not exactly the same as ISIC Rev.3.

From the table above one can see that Norway has a relatively high energy intensity compared to the USA in the following sectors:

- **Food and tobacco**
- **Paper, pulp, and printing**
- **Chemical**
- **Non-metallic minerals**
- **Iron and steel**
- **Non-ferrous metals**

Additionally, Norway has a similar energy intensity in the **wood and wood products** sector as the US, which is high compared to international standards.

19.5.2. Price of Energy

Electricity price for industry in 1st quarter of 2003 (excl. tax):

- For manufacturing sector excl. energy-intensive manufacturing and pulp and paper industry in 1st quarter of 2003: 31.4 øre/kWh (=0.045 US\$/kWh)
- For energy-intensive manufacturing and pulp and paper industry in 1st quarter of 2003: 11.3 øre/kWh (=0.016 US\$/kWh)

Natural gas price for industry in 2001 (excl. tax):
 $0.911 \text{ NOK/m}^3 = 0.101 \text{ US\$/m}^3$

Pit coal price for industry in 2001 (excl. tax):
 $0.360 \text{ NOK/kg} = 0.040 \text{ US\$/kg}$

Light fuel oil price for industry in 4th quarter of 2002 (excl. tax):
 $3468 \text{ NOK/toe(NCV)} = 474.39 \text{ US\$/toe(NCV)}$

Low sulfur fuel oil price for industry in 3rd quarter of 2002 (excl. tax):
 $2557 \text{ NOK/toe(NCV)} = 349.77 \text{ US\$/toe(NCV)}$

Sources:

For electricity, natural gas, and pit coal: Statistics Norway (<http://www.ssb.no>)

For fuel oil: International Energy Agency: Energy Prices & Taxes, Quarterly Statistics, Fourth Quarter 2002.

For a more detailed breakdown of electricity and other energy carrier costs by industry sectors and sub-sectors see Tab. 19.5.2 – 19.5.11.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane (LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquefied natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
15-37 MANUFACTURING	17.5	360	1 081	85	114	7.9	7 432	3 445	3 882	3 400	2 537	2 629	1 980	786	3 290	55	2 407	911	1 842	36	11
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	28	-	-	-	508	7.8	7 482	3 569	3 404	3 451	3 439	2 261	2 170	2 975	3 705	-	-	1 599	1 521	29	170
17-19 TEXTILES AND TEXTILE PROD., LEATHER AND LEATHER PRODUCTS	27	-	-	-	-	8.3	7 932	4 065	3 000	3 500	6 018	-	2 489	-	4 465	-	-	-	2 698	46	-
20 WOOD AND WOOD PRODUCTS	29.4	-	-	-	111	8.2	7 268	3 520	3 789	3 632	9 429	-	1 914	-	-	-	-	-	3 151	28	-
21 PULP, PAPER AND PAPER PRODUCTS	18	-	-	-	122	8.1	7 098	3 356	5 667	2 982	3 223	-	1 842	1 318	2 627	-	2 164	-	1 807	-	2
22 PUBLISHING AND PRINTING ETC.	31.7	-	-	-	-	7.9	7 283	3 571	-	3 524	4 582	-	3 250	-	6 000	-	-	-	-	40	-
23 COAL AND REFINED PETROLEUM PRODUCTS	19.1	-	-	-	-	8.9	10 500	4 533	-	3 447	2 666	-	-	-	-	-	-	-	-	-	-
24 CHEMICALS AND CHEMICAL PRODUCTS	19.5	-	-	-	-	8.4	7 214	3 179	4 167	3 102	1 852	3 552	2 081	1 454	2 778	-	-	622	1 830	-	14
25 RUBBER AND PLASTIC PRODUCTS	29.2	-	-	-	-	8.1	7 495	3 023	-	3 750	6 362	3 016	-	714	5 598	400	-	-	2 273	22	19
26 OTHER NON-METALLIC MINERAL PRODUCTS	24.6	360	1 081	85	154	7.7	7 058	3 413	4 018	3 478	2 989	3 485	3 000	533	-	-	-	-	-	44	1
27 BASIC METALS	13.4	-	-	-	103	8.2	5 132	3 449	4 500	3 473	3 109	3 360	2 392	-	-	-	-	1 958	1 874	44	17
28 METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	33	-	947	-	-	7.9	7 776	3 643	3 635	3 449	5 196	4 466	-	721	7 000	-	-	-	-	27	-
29 MACHINERY AND EQUIPMENT N.E.C	32.5	-	-	-	500	8.2	7 811	3 668	4 165	3 697	5 278	4 000	2 667	77	5 000	1	7 930	3 216	-	37	-
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	29.1	-	-	-	-	8	7 955	3 848	-	3 200	2 700	6 613	-	1 447	4 000	-	-	-	-	35	-
34-35 (without 35.114/5) TRANSPORT EQUIPMENT	32	-	-	-	553	8.1	7 738	3 462	4 091	2 980	5 315	2 650	-	692	3 155	-	-	-	6 303	39	20
35.114/5 OIL PLATFORMS	28.7	-	-	-	-	7.8	8 085	3 534	-	2 441	4 294	-	2 818	-	2 500	-	-	-	-	36	-
34 Motor vehicles, trailers and semitrailers	30.6	-	-	-	553	8	7 348	3 540	2 000	2 779	7 072	3 167	-	500	8 067	-	-	-	6 303	40	-
35(-35.114/5) Other transport equipment	33.4	-	-	-	-	8.2	7 851	3 452	4 300	3 441	3 719	2 448	-	703	3 122	-	-	-	-	38	20
36-37 MANUF. N.E.C.	35.1	-	-	-	228	7.7	7 462	3 647	4 167	3 644	4 000	-	-	-	7 429	-	-	2 741	-	-	15

Tab. 19.5.2: Energy prices in Norway (excl. tax), by industry sector and energy type for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane (LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	28	-	-	-	508	7.8	7 482	3 569	3 404	3 451	3 439	2 261	2 170	2 975	3 705	-	-	1 599	1 521	29	170
15.1 Meat and meat products	26.7	-	-	-	2 000	7.9	7 303	3 816	-	3 710	3 850	3 058	2 837	1 000	-	-	-	-	-	32	-
15.2 Fish and fish products	31	-	-	-	-	8.1	7 457	3 662	3 357	2 992	3 151	1 958	1 952	3 469	3 755	-	-	1 489	-	42	170
15.51 Dairies and cheese making	26	-	-	-	-	8.8	7 158	4 835	-	3 499	2 568	3 631	3 127	-	-	-	-	1 425	-	-	-
15.6-7 Grain mill products, starchers and animal feeds	28.6	-	-	-	181	8.8	7 031	3 275	-	3 584	3 627	-	3 514	-	3 572	-	-	2 371	2 273	-	-
15.81 Bread, fresh pastry goods and cakes	32.7	-	-	-	-	8.5	8 106	3 552	-	3 521	8 435	-	-	-	-	-	-	-	-	-	-
15.3-4/52/82-89 Other food products	25.2	-	-	-	-	7.8	7 948	3 550	6 000	3 571	3 431	3 164	2 740	-	8 500	-	-	-	1 248	25	-
15.96-98 Breweries	26.6	-	-	-	-	7.7	7 747	3 360	-	3 330	-	2 203	2 566	-	-	-	-	-	3 509	-	-
15.91-95/16 Other beverages and tobacco products	25.7	-	-	-	-	7.4	6 612	-	-	3 255	-	3 357	-	-	-	-	-	-	-	28	-

Tab. 19.5.3: Energy prices in Norway (excl. tax) for the food and tobacco sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	27	-	-	-	-	8.3	7 932	4 065	3 000	3 500	6 018	-	2 489	-	4 465	-	-	-	2 698	46	-
17 Textiles	25.5	-	-	-	-	8.1	7 976	4 115	3 000	3 472	5 981	-	2 489	-	4 465	-	-	-	2 698	46	-
18 Wearing apparel, dressing and dyeing of fur	36.7	-	-	-	-	8.7	7 825	3 636	-	3 676	6 261	-	-	-	-	-	-	-	-	-	-
19 Leather and leather products	32.9	-	-	-	-	7.6	7 857	-	-	3 581	-	-	-	-	-	-	-	-	-	-	-

Tab. 19.5.4: Energy prices in Norway (excl. tax) for the textile sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
20 WOOD AND WOOD PRODUCTS	29.4	-	-	-	111	8.2	7 268	3 520	3 789	3 632	9 429	-	1 914	-	-	-	-	-	3 151	28	-
20.101 Sawmilling and planing of wood	30.7	-	-	-	42	8.1	6 996	3 504	-	3 786	-	-	2 694	-	-	-	-	-	3 185	-	-
20.102-5 Other wood products	28.6	-	-	-	157	8.3	7 571	3 559	3 737	3 582	9 429	-	1 911	-	-	-	-	-	3 138	28	-

Tab. 19.5.5: Energy prices in Norway (excl. tax) for the wood industry sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
21 PULP, PAPER AND PAPER PRODUCTS	18	-	-	-	122	8.1	7 098	3 356	5 667	2 982	3 223	-	1 842	1 318	2 627	-	2 164	-	1 807	-	2
21.11 Pulp	19.6	-	-	-	111	8	7 091	3 371	-	3 531	-	-	1 857	1 345	2 627	-	-	-	1 585	-	-
21.111 Mechanical pulp	17.3	-	-	-	111	-	-	2 565	-	3 394	-	-	2 012	-	-	-	-	-	-	-	-
21.112 Chemical processed pulp	21.8	-	-	-	-	8	7 091	3 451	-	3 639	-	-	1 851	1 345	2 627	-	-	-	1 585	-	-
21.12 Paper and paperboard	17.4	-	-	-	122	8.6	7 040	3 336	5 667	1 839	3 083	-	1 811	1 300	-	-	2 164	-	1 980	-	2
21.2 Articles of paper and paperboard	23.7	-	-	-	-	7.4	7 447	4 000	-	3 415	4 141	-	1 961	-	-	-	-	-	1 527	-	14
22 PUBLISHING AND PRINTING ETC.	31.7	-	-	-	-	7.9	7 283	3 571	-	3 524	4 582	-	3 250	-	6 000	-	-	-	-	40	-
22.1 Publishing	31.4	-	-	-	-	7.9	7 604	-	-	3 485	-	-	3 250	-	-	-	-	-	-	42	-
22.2 Printing etc.	31.7	-	-	-	-	7.9	7 152	3 571	-	3 641	4 582	-	-	-	-	-	-	-	-	39	-
22.3 Reproduction of recorded media	38.5	-	-	-	-	7.7	9 500	-	-	1 750	-	-	-	-	6 000	-	-	-	-	37	-

Tab. 19.5.6: Energy prices in Norway (excl. tax) for the paper and pulp sector, and the printing sector and their sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
24 CHEMICALS AND CHEMICAL PRODUCTS	19.5	-	-	-	-	8.4	7 214	3 179	4 167	3 102	1 852	3 552	2 081	1 454	2 778	-	-	622	1 830	-	14
24.1 Basic chemicals	19.2	-	-	-	-	9	7 182	3 133	4 000	3 045	1 844	3 274	2 078	-	2 778	-	-	622	1 743	-	13
24.3 Paints, varnishes and similar coatings, printing ink and mastics	26.6	-	-	-	-	7.8	8 227	5 400	-	2 229	-	-	-	-	-	-	-	-	4 085	-	-
24.4 Pharmaceuticals, medicinal chemicals and botanical products	27.2	-	-	-	-	8	7 667	-	-	3 541	2 647	3 590	-	-	-	-	-	-	-	-	48
24.5 Soap and detergents, cleaning and polishing prep., perfumes and toilet prep.	25.3	-	-	-	-	7.8	8 588	3 667	-	3 554	-	-	-	-	-	-	-	-	-	-	-
24.2/6 Other chemicals and chemical products	31.3	-	-	-	-	7.4	6 821	3 600	4 200	3 123	9 500	-	2 727	1 454	-	-	-	-	3 529	-	-

Tab. 19.5.7: Energy prices in Norway (excl. tax) for the chemical industry sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
26 OTHER NON-METALLIC MINERAL PRODUCTS	24.6	360	1 081	85	154	7.7	7 058	3 413	4 018	3 478	2 989	3 485	3 000	533	-	-	-	-	-	44	1
26.1 Glass and glass products	25.1	-	-	-	-	8.3	7 907	3 939	4 236	3 145	3 186	-	-	-	-	-	-	-	-	56	-
26.2-3 Ceramic products	26.6	-	-	-	500	8.4	6 621	4 115	-	3 522	3 339	-	-	-	-	-	-	-	-	-	-
26.4 Bricks, tiles and construction products, in baked clay	29.4	-	-	-	-	-	-	3 087	-	3 103	3 256	-	-	-	-	-	-	-	-	-	-
26.5 Cement, lime and plaster	20.5	356	-	85	-	7.7	6 817	2 454	-	2 431	3 865	-	-	347	-	-	-	-	-	-	1
26.6 Articles of concrete, cement and plaster	32.6	421	-	-	150	7.6	6 985	3 673	3 890	3 590	2 674	3 485	-	711	-	-	-	-	-	41	5
26.7 Cutting, sharpening and finishing of stone	33.4	-	-	-	500	7.6	7 363	3 306	-	3 459	14 500	-	3 000	-	-	-	-	-	-	-	-
26.8 Other non-metallic mineral products	22.9	-	1 081	-	364	-	6 782	3 427	-	3 585	3 154	-	-	810	-	-	-	-	-	-	5

Tab. 19.5.8: Energy prices in Norway (excl. tax) for the non-metallic minerals industry sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquefied natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
27 BASIC METALS	13.4	-	-	-	103	8.2	5 132	3 449	4 500	3 473	3 109	3 360	2 392	-	-	-	-	1 958	1 874	44	17
27.1 Basic iron, steel and ferro-alloys (ecsc)	9.9	-	-	-	-	10	-	2 497	-	3 322	4 469	-	-	-	-	-	-	-	-	16	17
27.2 Iron and steel tubes	31.3	-	-	-	-	8.4	7 762	3 782	-	3 273	7 800	-	-	-	-	-	-	-	-	-	-
27.3 Other first processing of iron and steel and production of non-ecsc ferro-alloys	13.1	-	-	-	102	8.5	8 294	3 343	-	3 031	2 930	-	-	-	-	-	-	-	-	-	-
27.421 Primary aluminium	13.2	-	-	-	-	7.8	4 064	3 443	-	3 753	3 772	3 360	-	-	-	-	-	2 030	-	-	-
27.422 First transformation of aluminium	23.3	-	-	-	-	9.2	7 571	4 068	-	4 015	2 552	-	-	-	-	-	-	1 791	-	-	-
27.43 Lead, zink and tin	11.4	-	-	-	-	8	7 000	4 460	-	4 061	6 293	-	-	-	-	-	-	-	-	-	-
27.41/44-45 Other non-ferrous metals and semi-finished products	16.2	-	-	-	-	6.8	7 500	4 800	-	3 867	2 847	-	2 392	-	-	-	-	-	1 874	-	16
27.5 Casting of metals	26.8	-	-	-	950	7.9	5 304	3 621	4 500	2 485	3 867	-	-	-	-	-	-	-	-	54	-
28 METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	33	-	947	-	-	7.9	7 776	3 643	3 635	3 449	5 196	4 466	-	721	7 000	-	-	-	-	27	-
28.1 Fabricated metal products, except machinery and equipment	34.4	-	-	-	-	7.7	7 872	3 883	3 627	3 409	7 414	3 905	-	-	-	-	-	-	-	33	-
28.5 Treatment and coating of metals, general mechanical engineering	34	-	947	-	-	8.2	7 776	3 618	5 000	3 344	6 129	-	-	1 000	7 000	-	-	-	-	23	-
28.6 Cutlery, tools and general hardware	30.8	-	-	-	-	8	7 517	3 600	-	3 829	4 864	-	-	-	-	-	-	-	-	-	-
28.2-4/7 Other metal products	31.9	-	-	-	-	8.3	7 640	3 200	-	3 468	3 469	4 560	-	707	-	-	-	-	-	41	-

Tab. 19.5.9: Energy prices in Norway (excl. tax) for the metal industry sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquefied natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
29 MACHINERY AND EQUIPMENT N.E.C	32.5	-	-	-	500	8.2	7 811	3 668	4 165	3 697	5 278	4 000	2 667	77	5 000	1	7 930	3 216	-	37	-
29.1 Machinery for the production/use of mech. power, exc. aircraft, vehicle engines	31.1	-	-	-	-	7.9	7 749	3 585	4 234	4 018	5 523	-	2 667	-	3 000	-	7 930	3 216	-	-	-
29.2 Other general purpose machinery	36.5	-	-	-	-	8.4	7 999	3 962	3 800	3 658	6 126	4 000	-	1 000	6 000	1	-	-	-	37	-
29.3 Agricultural and forestry machinery	29.1	-	-	-	-	7.8	7 649	3 757	-	3 633	5 211	-	-	-	-	-	-	-	-	38	-
29.4 Machine-tools	32.8	-	-	-	-	7.9	7 863	3 750	-	4 076	-	-	-	-	-	-	-	-	-	-	-
29.5 Other special purpose machinery	36.8	-	-	-	500	8.4	7 562	3 639	-	3 478	4 556	-	-	-	-	-	-	-	-	37	-
29.6 Weapons and ammunition	30	-	-	-	-	8.1	10 000	-	-	2 718	-	-	-	-	-	-	-	-	-	36	-
29.7 Domestic appliances n.e.c.	29.1	-	-	-	-	8.3	8 667	4 000	-	3 411	6 355	-	-	-	-	-	-	-	-	36	-
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	29.1	-	-	-	-	8	7 955	3 848	-	3 200	2 700	6 613	-	1 447	4 000	-	-	-	-	35	-
30 Office machinery and computers	27.8	-	-	-	-	7.2	-	-	-	3 500	-	-	-	-	-	-	-	-	-	-	-
31 Electrical machinery and apparatus n.e.c.	27.8	-	-	-	-	8	8 212	3 858	-	3 157	2 700	6 613	-	1 447	7 000	-	-	-	-	35	-
32 Radio, television, communication equipment and apparatus	31.3	-	-	-	-	7.5	8 500	2 000	-	4 097	-	-	-	-	-	-	-	-	-	34	-
33 Medical, precision and optical instruments	31.2	-	-	-	-	8.2	7 493	4 000	-	2 909	-	-	-	-	3 857	-	-	-	-	37	-

Tab. 19.5.10: Energy prices in Norway (excl. tax) for the machinery sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

	Electricity	Pit coal, briquettes	Coke and semi-coke of coal	Petrol coke	Fire wood, waste of wood	Gasoline	Auto diesel, dutiable	Auto diesel, non-dutiable	Kerosene	Light heating oils	Propane and butane(LNG)	Heavy distillates	Heavy fuel oils	Waste oil	Marine gas oils	Other energy types for transport	Liquified natural gas (LNG)	Natural gas (in gaseous form)	Steam	District heating	Other purchased energy n.e.c.
	Øre per kWh	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per m³	NOK per liter	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	NOK per M.T.	Øre per kWh	NOK per M.T.	NOK per 1 000 Sm³	NOK per toe	Øre per kWh	Øre per kWh
34-35 (excl. 35.114/5) TRANSPORT EQUIPMENT	32	-	-	-	553	8.1	7 738	3 462	4 091	2 980	5 315	2 650	-	692	3 155	-	-	-	6 303	39	20
34 Motor vehicles, trailers and semitrailers	30.6	-	-	-	553	8	7 348	3 540	2 000	2 779	7 072	3 167	-	500	8 067	-	-	-	6 303	40	-
35(excl. 35.114/5) Other transport equipment	33.4	-	-	-	-	8.2	7 851	3 452	4 300	3 441	3 719	2 448	-	703	3 122	-	-	-	-	38	20
35.114/5 OIL PLATFORMS	28.7	-	-	-	-	7.8	8 085	3 534	-	2 441	4 294	-	2 818	-	2 500	-	-	-	-	36	-

Tab. 19.5.11: Energy prices in Norway (excl. tax) for the transport equipment sector and its sub-sectors for 2001 (Source: Statistics Norway)

Note: Average exchange rate in 2001: 100 Øre = 1 NOK = 0.11138 US\$

Note: Electricity prices include grid rent.

19.5.3. Growth Rate of Energy Consumption

The energy consumption in the manufacturing sector (ISIC sections 15-37) grew by 1.2 % on average between 1994 and 1999 (IEA Energy Balances, 2001). However, from 2000 to 2001, the energy consumption in the manufacturing sector (ISIC codes 15-37) decreased by 2.0 % (Statistics Norway).

The most energy consuming industry sector is aluminum manufacturing, which accounts for about one third of overall industrial electricity use.

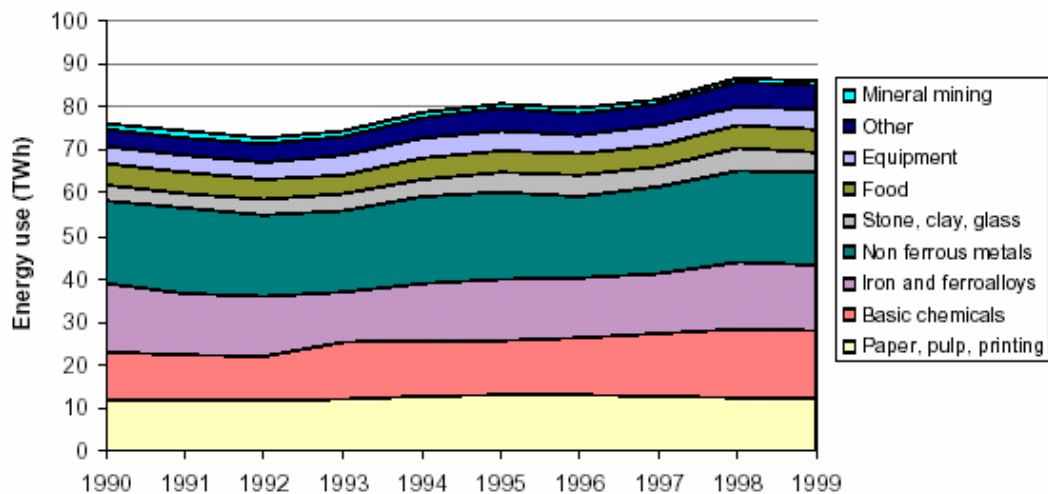


Fig. 19.5.2: Trends in energy use per industry sector (Source: ODYSSEE)

The following table shows the change in energy consumption for the manufacturing sector and its sub-sectors between 2000 and 2001:

Industry sector	2000		2001		Changes	
	MWh	Fraction in per cent	MWh	Fraction in per cent	MWh	Per cent
10,12-37 MANUFACTURING, MINING AND QUARRYING	81 670 239	100.0	80 142 631	100.0	-1 527 608	-1.9
10,12-14 MINING AND QUARRYING	1 106 597	1.4	1 198 580	1.5	91 983	8.3
10 Coal and peat	69 819	0.1	111 281	0.1	41 462	59.4
13 Metal ores	284 043	0.3	279 299	0.3	-4 744	-1.7
14 Other mining and quarrying	752 736	0.9	808 001	1	55 265	7.3
15-37 MANUFACTURING	80 563 641	98.6	78 944 050	98.5	-1 619 591	-2
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	5 191 697	6.4	4 755 547	5.9	-436 150	-8.4
15.1 Meat and meat products	727 309	0.9	675 525	0.8	-51 784	-7.1
15.2 Fish and fish products	1 505 232	1.8	1 235 389	1.5	-269 843	-17.9
15.51 Dairies and cheese making	610 615	0.7	576 832	0.7	-33 783	-5.5
15.6-7 Grain mill products, starchers and animal feeds	707 714	0.9	677 500	0.8	-30 214	-4.3
15.81 Bread, fresh pastry goods and cakes	414 665	0.5	341 707	0.4	-72 958	-17.6
15.3-4/52/82-89 Other food products	870 884	1.1	850 428	1.1	-20 456	-2.3
15.96-98 Breweries	301 994	0.4	344 525	0.4	42 531	14.1
15.91-95/16 Other beverages and tobacco products	53 284	0.1	53 642	0.1	358	0.7
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	342 259	0.4	329 452	0.4	-12 807	-3.7
17 Textiles	287 615	0.4	282 218	0.4	-5 397	-1.9
18 Wearing apparel, dressing and dyeing of fur	33 861	-	26 922	-	-6 939	-20.5
19 Leather and leather products	20 783	-	20 311	-	-472	-2.3
20 WOOD AND WOOD PRODUCTS	2 523 041	3.1	2 235 486	2.8	-287 555	-11.4
20.101 Sawmilling and planing of wood	1 362 304	1.7	1 116 262	1.4	-246 042	-18.1
20.102-5 Other wood products	1 160 737	1.4	1 119 224	1.4	-41 513	-3.6
21 PULP, PAPER AND PAPER PRODUCTS	15 049 967	18.4	15 694 815	19.6	644 848	4.3
21.11 Pulp	5 315 501	6.5	6 104 477	7.6	788 976	14.8
21.111 Mechanical pulp	473 254	0.6	431 192	0.5	-42 062	-8.9
21.112 Chemical processed pulp	4 842 247	5.9	5 673 285	7.1	831 038	17.2
21.12 Paper and paperboard	9 354 586	11.5	9 196 364	11.5	-158 222	-1.7
21.2 Articles of paper and paperboard	379 880	0.5	393 974	0.5	14 094	3.7
22 PUBLISHING AND PRINTING ETC.	565 200	0.7	471 000	0.6	-94 200	-16.7
22.1 Publishing	177 430	0.2	133 148	0.2	-44 282	-25
22.2 Printing etc.	383 323	0.5	333 951	0.4	-49 372	-12.9
22.3 Reproduction of recorded media	4 446	-	3 900	-	-546	-12.3
23 COAL AND REFINED PETROLEUM PRODUCTS	6 299 414	7.7	5 925 537	7.4	-373 877	-5.9
24 CHEMICALS AND CHEMICAL PRODUCTS	13 292 475	16.3	13 745 187	17.2	452 712	3.4
24.1 Basic chemicals	12 798 695	15.7	13 274 234	16.6	475 539	3.7
24.3 Paints, varnishes and similar coatings, printing ink and mastics	49 655	0.1	45 964	0.1	-3 691	-7.4
24.4 Pharmaceuticals, medicinal chemicals and botanical products	263 700	0.3	260 970	0.3	-2 730	-1
24.5 Soap and detergents, cleaning and polishing prep., perfumes and toilet prep.	53 899	0.1	49 859	0.1	-4 040	-7.5
24.2/6 Other chemicals and chemical products	126 526	0.2	114 161	0.1	-12 365	-9.8
25 RUBBER AND PLASTIC PRODUCTS	531 126	0.7	524 098	0.7	-7 028	-1.3
25.1 Rubber products	13 857	-	12 535	-	-1 322	-9.5
25.2 Plastic products	517 269	0.6	511 563	0.6	-5 706	-1.1
26 OTHER NON-METALLIC MINERAL PRODUCTS	3 665 015	4.5	3 605 524	4.5	-59 491	-1.6
26.1 Glass and glass products	315 619	0.4	309 845	0.4	-5 774	-1.8
26.2-3 Ceramic products	95 994	0.1	105 074	0.1	9 080	9.5
26.4 Bricks, tiles and construction products, in baked clay	41 306	0.1	33 778	-	-7 528	-18.2
26.5 Cement, lime and plaster	1 841 025	2.3	1 908 912	2.4	67 887	3.7
26.6 Articles of concrete, cement and plaster	609 926	0.7	560 045	0.7	-49 881	-8.2
26.7 Cutting, sharpening and finishing of stone	34 931	-	41 158	0.1	6 227	17.8
26.8 Other non-metallic mineral products	726 214	0.9	646 712	0.8	-79 502	-10.9

Industry sector	2000		2001		Changes	
	MWh	Fraction in per cent	MWh	Fraction in per cent	MWh	Per cent
27 BASIC METALS	29 084 674	35.6	28 394 132	35.4	-690 542	-2.4
27.1 Basic iron , steel and ferro-alloys (ecsc)	1 040 425	1.3	1 158 394	1.4	117 969	11.3
27.2 Iron and steel tubes	29 072	-	53 069	0.1	23 997	82.5
27.3 Other first processing of iron and steel and production of non-ecsc ferro-alloys	7 223 775	8.8	6 610 959	8.2	-612 816	-8.5
27.421 Primary aluminium	17 580 648	21.5	17 378 877	21.7	-201 771	-1.1
27.422 First transformation of aluminium	497 022	0.6	452 183	0.6	-44 839	-9
27.43 Lead, zink and tin	739 913	0.9	769 476	1	29 563	4
27.41/44-45 Other non-ferrous metals and semi-finished products	1 744 904	2.1	1 751 189	2.2	6 285	0.4
27.5 Casting of metals	228 917	0.3	219 984	0.3	-8 933	-3.9
28 METAL PRODUCTS,EXCEPT MACHINERY AND EQUIPMENT	790 494	1	545 537	0.7	-244 957	-31
28.1 Fabricated metal products, except machinery and equipment	302 561	0.4	152 269	0.2	-150 292	-49.7
28.5 Treatment and coating of metals, general mechanical engineering	197 203	0.2	163 636	0.2	-33 567	-17
28.6 Cutlery, tools and general hardware	49 637	0.1	42 527	0.1	-7 110	-14.3
28.2-4/7 Other metal products	241 092	0.3	187 105	0.2	-53 987	-22.4
29 MACHINERY AND EQUIPMENT N.E.C	758 038	0.9	674 801	0.8	-83 237	-11
29.1 Machinery for the production/use of mech. power, excl. aircraft,vehicle engines	136 872	0.2	173 380	0.2	36 508	26.7
29.2 Other general purpose machinery	234 804	0.3	145 411	0.2	-89 393	-38.1
29.3 Agricultural and forestry machinery	125 030	0.2	117 005	0.1	-8 025	-6.4
29.4 Machine-tools	18 962	-	15 294	-	-3 668	-19.3
29.5 Other special purpose machinery	113 839	0.1	88 697	0.1	-25 142	-22.1
29.6 Weapons and ammunition	62 379	0.1	66 578	0.1	4 199	6.7
29.7 Domestic appliances n.e.c.	66 152	0.1	68 436	0.1	2 284	3.5
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	594 393	0.7	466 828	0.6	-127 565	-21.5
30 Office machinery and computers	7 154	-	6 350	-	-804	-11.2
31 Electrical machinery and apparatus n.e.c.	404 733	0.5	325 093	0.4	-79 640	-19.7
32 Radio, television, communication equipment and apparatus	86 162	0.1	53 052	0.1	-33 110	-38.4
33 Medical, precision and optical instruments	96 344	0.1	82 333	0.1	-14 011	-14.5
34-35(-35.114/5) TRANSPORT EQUIPMENT	757 351	0.9	727 686	0.9	-29 665	-3.9
34 Motor vehicles, trailers and semitrailers	363 226	0.4	341 926	0.4	-21 300	-5.9
35(-35.114/5) Other transport equipment	394 126	0.5	385 759	0.5	-8 367	-2.1
35.114/5 OIL PLATFORMS	312 332	0.4	269 167	0.3	-43 165	-13.8
36-37 MANUFACTURING N.E.C.	806 167	1	579 252	0.7	-226 915	-28.1
36.1 Furniture	424 116	0.5	310 397	0.4	-113 719	-26.8
36.2-6 Manufacturing n.e.c.	112 747	0.1	81 133	0.1	-31 614	-28
37 Recycling	269 305	0.3	187 722	0.2	-81 583	-30.3

Tab. 19.5.12: Change in energy consumption for the manufacturing sector and its sub-sectors between 2000 and 2001. Source: Statistics Norway.

Note: Energy consumption (expressed in kWh) includes all types of energy carriers (electricity, oil, gas, etc.).

19.5.4. Potential Replicability of Exports (Size of Market)

The total energy consumption (all types of energy carriers) in the manufacturing sector (ISIC divisions 15-37) was 78,944 GWh in 2001 (Statistics Norway).

The following table shows the energy consumption in 2001 broken down by industry sub-sector and type of energy carrier (only major types of energy carriers included):

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane(LNG)	Heavy fuel oils	Natural gas (in gaseous form)
15-37 MANUFACTURING	78 944 050	48 076 410	1 203 929	2 091 620	2 238 721	2 791 523	2 088 473
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	4 755 547	2 920 015	-	692 953	109 700	308 315	77 591
15.1 Meat and meat products	675 525	488 576	-	96 439	18 247	6 590	-
15.2 Fish and fish products	1 235 389	622 359	-	126 526	13 949	232 040	66 488
15.51 Dairies and cheese making	576 832	419 574	-	53 604	15 662	805	1 350
15.6-7 Grain mill products, starchers and animal feeds	677 500	384 764	-	144 693	46 759	14 658	9 754
15.81 Bread, fresh pastry goods and cakes	341 707	239 957	-	68 892	296	-	-
15.3-4/52/82-89 Other food products	850 428	547 794	-	132 507	14 787	23 637	-
15.96-98 Breweries	344 525	193 481	-	59 458	-	30 585	-
15.91-95/16 Other beverages and tobacco products	53 642	23 511	-	10 835	-	-	-
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	329 452	203 126	-	53 452	4 308	17 052	-
17 Textiles	282 218	171 219	-	41 987	4 017	17 052	-
18 Wearing apparel, dressing and dyeing of fur	26 922	21 348	-	2 580	291	-	-
19 Leather and leather products	20 311	10 559	-	8 886	-	-	-
20 WOOD AND WOOD PRODUCTS	2 235 486	718 926	-	51 527	361	105 981	-
20.101 Sawmilling and planing of wood	1 116 262	274 521	-	12 504	-	406	-
20.102-5 Other wood products	1 119 224	444 405	-	39 023	361	105 575	-
21 PULP, PAPER AND PAPER PRODUCTS	15 694 815	6 371 462	-	61 907	18 240	1 576 692	-
21.11 Pulp	6 104 477	648 987	-	31 038	1	884 357	-
21.111 Mechanical pulp	431 192	314 306	-	13 714	1	33 595	-
21.112 Chemical processed pulp	5 673 285	334 681	-	17 324	-	850 762	-
21.12 Paper and paperboard	9 196 364	5 408 102	-	19 298	15 889	637 549	-
21.2 Articles of paper and paperboard	393 974	314 373	-	11 571	2 350	54 786	-

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane(LNG)	Heavy fuel oils	Natural gas (in gaseous form)
22 PUBLISHING AND PRINTING ETC.	471 000	368 936	-	10 119	48 848	45	-
22.1 Publishing	133 148	109 068	-	5 257	-	45	-
22.2 Printing etc.	333 951	256 412	-	4 667	48 848	-	-
22.3 Reproduction of recorded media	3 900	3 456	-	195	-	-	-
23 COAL AND REFINED PETROLEUM PRODUCTS	5 925 537	432 602	-	4 715	124 240	-	-
24 CHEMICALS AND CHEMICAL PRODUCTS	13 745 187	7 357 698	-	205 959	1 129 756	538 322	1 640 250
24.1 Basic chemicals	13 274 234	7 087 012	-	130 393	1 118 873	535 514	1 640 250
24.3 Paints, varnishes and similar coatings, printing ink and mastics	45 964	24 420	-	16 311	-	-	-
24.4 Pharmaceuticals, medicinal chemicals and botanical products	260 970	150 069	-	37 716	10 859	-	-
24.5 Soap and detergents, cleaning and polishing prep., perfumes and toilet prep.	49 859	35 975	-	11 085	-	-	-
24.2/6 Other chemicals and chemical products	114 161	60 223	-	10 454	24	2 808	-
25 RUBBER AND PLASTIC PRODUCTS	524 098	414 841	-	66 657	3 011	-	-
25.1 Rubber products	12 535	7 682	-	2 920	-	-	-
25.2 Plastic products	511 563	407 159	-	63 737	3 011	-	-
26 OTHER NON-METALLIC MINERAL PRODUCTS	3 605 524	801 106	1 203 929	239 376	408 479	449	-
26.1 Glass and glass products	309 845	171 303	-	11 557	112 763	-	-
26.2-3 Ceramic products	105 074	42 876	-	5 943	54 130	-	-
26.4 Bricks, tiles and construction products, in baked clay	33 778	4 724	-	690	28 094	-	-
26.5 Cement, lime and plaster	1 908 912	231 427	1 120 074	17 096	5 700	-	-
26.6 Articles of concrete, cement and plaster	560 045	122 018	83 855	78 606	184 018	-	-
26.7 Cutting, sharpening and finishing of stone	41 158	17 539	-	3 936	29	449	-
26.8 Other non-metallic mineral products	646 712	211 219	-	121 548	23 744	-	-
27 BASIC METALS	28 394 132	26 206 420	-	323 402	236 802	243 194	330 581
27.1 Basic iron, steel and ferro-alloys (ecsc)	1 158 394	893 031	-	136 980	2 509	-	-
27.2 Iron and steel tubes	53 069	48 894	-	1 311	195	-	-
27.3 Other first processing of iron and steel and production of non-ecsc ferro-alloys	6 610 959	6 060 423	-	13 098	4 559	-	-
27.421 Primary aluminium	17 378 877	16 837 227	-	139 569	88 652	-	230 895
27.422 First transformation of aluminium	452 183	204 767	-	3 252	122 242	-	99 686
27.43 Lead, zink and tin	769 476	651 973	-	3 723	1 050	-	-
27.41/44-45 Other non-ferrous metals and semi-finished products	1 751 189	1 319 319	-	6 489	10 680	243 194	-
27.5 Casting of metals	219 984	190 787	-	18 981	6 916	-	-

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane(LNG)	Heavy fuel oils	Natural gas (in gaseous form)
28 METAL PRODUCTS,EXCEPT MACHINERY AND EQUIPMENT	545 537	410 102	-	69 666	12 362	-	-
28.1 Fabricated metal products, except machinery and equipment	152 269	104 301	-	25 684	1 482	-	-
28.5 Treatment and coating of metals, general mechanical engineering	163 636	116 603	-	21 612	5 678	-	-
28.6 Cutlery, tools and general hardware	42 527	31 714	-	7 897	282	-	-
28.2-4/7 Other metal products	187 105	157 484	-	14 473	4 921	-	-
29 MACHINERY AND EQUIPMENT N.E.C	674 801	480 860	-	106 725	20 171	1 353	4 523
29.1 Machinery for the production/use of mech. power, exc. aircraft,vehicle engines	173 380	120 543	-	31 832	1 662	1 353	4 523
29.2 Other general purpose machinery	145 411	110 828	-	19 371	1 118	-	-
29.3 Agricultural and forestry machinery	117 005	70 619	-	25 573	14 869	-	-
29.4 Machine-tools	15 294	12 709	-	1 718	5	-	-
29.5 Other special purpose machinery	88 697	59 042	-	14 768	1 730	-	-
29.6 Weapons and ammunition	66 578	51 961	-	2 078	-	-	-
29.7 Domestic appliances n.e.c.	68 436	55 159	-	11 386	788	-	-
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	466 828	347 976	-	11 541	70 174	-	-
30 Office machinery and computers	6 350	5 924	-	192	-	-	-
31 Electrical machinery and apparatus n.e.c.	325 093	214 858	-	9 559	70 174	-	-
32 Radio, television, communication equipment and apparatus	53 052	50 995	-	740	-	-	-
33 Medical, precision and optical instruments	82 333	76 199	-	1 051	-	-	-
34-35(-35.114/5) TRANSPORT EQUIPMENT	727 686	522 202	-	107 192	15 031	-	-
34 Motor vehicles, trailers and semitrailers	341 926	247 526	-	74 620	7 161	-	-
35(-35.114/5) Other transport equipment	385 759	274 676	-	32 572	7 870	-	-
35.114/5 OIL PLATFORMS	269 167	206 653	-	35 523	10 205	120	-
36-37 MANUFACTURING N.E.C.	579 252	313 485	-	50 905	27 033	-	35 528
36.1 Furniture	310 397	187 523	-	42 008	140	-	-
36.2-6 Manufacturing n.e.c.	81 133	62 480	-	8 897	38	-	-
37 Recycling	187 722	63 482	-	-	26 855	-	35 528

Tab. 19.5.13: Energy consumption (in kWh) in 2001 broken down by industry sub-sector and type of energy carrier (only major types of energy carriers included). Source: Statistics Norway.

*Note: Total includes also minor fuels not shown in this table. Full table at <http://www.ssb.no>

The following table shows the energy expenditures in 2001 broken down by industry sub-sector and type of energy carrier (only major types of energy carriers included), which is an indicator of the size of the industry sectors and, therefore, for the replicability of potential exports:

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane (LNG)	Heavy fuel oils	Natural gas (in gaseous form)
15-37 MANUFACTURING	11 273 291	8 422 194	55 533	593 916	443 599	490 038	169 144
15-16 FOOD PRODUCTS, BEVERAGES AND TOBACCO	1 353 545	817 214	-	199 756	29 462	59 318	11 027
15.1 Meat and meat products	202 756	130 569	-	29 887	5 486	1 657	-
15.2 Fish and fish products	317 756	193 233	-	31 622	3 431	40 167	8 800
15.51 Dairies and cheese making	176 884	109 106	-	15 665	3 141	222	171
15.6-7 Grain mill products, starchers and animal feeds	191 867	110 055	-	43 312	13 247	4 568	2 056
15.81 Bread, fresh pastry goods and cakes	121 128	78 538	-	20 258	194	-	-
15.3-4/52/82-89 Other food products	213 774	138 118	-	39 527	3 963	5 744	-
15.96-98 Breweries	114 443	51 554	-	16 539	-	6 960	-
15.91-95/16 Other beverages and tobacco products	14 937	6 041	-	2 946	-	-	-
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	86 720	54 943	-	15 629	2 022	3 764	-
17 Textiles	68 955	43 630	-	12 178	1 878	3 764	-
18 Wearing apparel, dressing and dyeing of fur	10 995	7 843	-	794	144	-	-
19 Leather and leather products	6 770	3 470	-	2 657	-	-	-
20 WOOD AND WOOD PRODUCTS	313 395	211 199	-	15 631	264	17 988	-
20.101 Sawmilling and planing of wood	123 363	84 276	-	3 953	-	97	-
20.102-5 Other wood products	190 032	126 923	-	11 678	264	17 891	-
21 PULP, PAPER AND PAPER PRODUCTS	1 591 968	1 145 225	-	15 422	4 589	257 555	-
21.11 Pulp	334 900	127 300	-	9 155	1	145 655	-
21.111 Mechanical pulp	65 394	54 353	-	3 889	1	5 995	-
21.112 Chemical processed pulp	269 506	72 947	-	5 266	-	139 660	-
21.12 Paper and paperboard	1 166 688	943 292	-	2 965	3 826	102 372	-
21.2 Articles of paper and paperboard	90 380	74 633	-	3 302	762	9 528	-
22 PUBLISHING AND PRINTING ETC.	162 013	116 907	-	2 978	17 482	13	-
22.1 Publishing	48 322	34 223	-	1 530	-	13	-
22.2 Printing etc.	112 187	81 352	-	1 420	17 482	-	-
22.3 Reproduction of recorded media	1 504	1 332	-	28	-	-	-
23 COAL AND REFINED PETROLEUM PRODUCTS	110 022	82 634	-	1 358	25 863	-	-

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane (LNG)	Heavy fuel oils	Natural gas (in gaseous form)
24 CHEMICALS AND CHEMICAL PRODUCTS	2 096 455	1 435 891	-	53 372	163 361	99 340	90 640
24.1 Basic chemicals	1 973 577	1 360 548	-	33 165	161 097	98 661	90 640
24.3 Paints, varnishes and similar coatings, printing ink and mastics	11 765	6 491	-	3 036	-	-	-
24.4 Pharmaceuticals, medicinal chemicals and botanical products	64 159	40 879	-	11 154	2 245	-	-
24.5 Soap and detergents, cleaning and polishing prep., perfumes and toilet prep.	12 622	9 094	-	3 291	-	-	-
24.2/6 Other chemicals and chemical products	34 332	18 879	-	2 726	19	679	-
25 RUBBER AND PLASTIC PRODUCTS	155 905	121 232	-	20 882	1 495	-	-
25.1 Rubber products	5 082	3 127	-	918	-	-	-
25.2 Plastic products	150 823	118 105	-	19 964	1 495	-	-
26 OTHER NON-METALLIC MINERAL PRODUCTS	508 185	197 267	55 533	69 537	95 339	120	-
26.1 Glass and glass products	76 834	43 032	-	3 035	28 060	-	-
26.2-3 Ceramic products	27 634	11 392	-	1 747	14 112	-	-
26.4 Bricks, tiles and construction products, in baked clay	8 786	1 391	-	180	7 144	-	-
26.5 Cement, lime and plaster	113 498	47 471	51 014	3 471	1 720	-	-
26.6 Articles of concrete, cement and plaster	135 511	39 829	4 519	23 571	38 427	-	-
26.7 Cutting, sharpening and finishing of stone	15 147	5 856	-	1 138	29	120	-
26.8 Other non-metallic mineral products	130 775	48 296	-	36 395	5 847	-	-
27 BASIC METALS	3 861 048	3 510 337	-	93 819	57 493	51 589	57 529
27.1 Basic iron, steel and ferro-alloys (ecsc)	149 065	88 606	-	38 006	876	-	-
27.2 Iron and steel tubes	16 993	15 285	-	360	117	-	-
27.3 Other first processing of iron and steel and production of non-ecsc ferro-alloys	819 779	795 614	-	3 316	1 043	-	-
27.421 Primary aluminium	2 357 023	2 223 269	-	43 748	26 115	-	41 663
27.422 First transformation of aluminium	90 375	47 685	-	1 092	24 364	-	15 866
27.43 Lead, zinc and tin	77 096	74 471	-	1 263	516	-	-
27.41/44-45 Other non-ferrous metals and semi-finished products	292 625	214 296	-	2 096	2 374	51 589	-
27.5 Casting of metals	58 092	51 111	-	3 938	2 088	-	-
28 METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	188 169	135 490	-	20 068	5 014	-	-
28.1 Fabricated metal products, except machinery and equipment	56 161	35 912	-	7 312	860	-	-
28.5 Treatment and coating of metals, general mechanical engineering	56 494	39 598	-	6 036	2 715	-	-
28.6 Cutlery, tools and general hardware	14 393	9 755	-	2 527	107	-	-
28.2-4/7 Other metal products	61 121	50 225	-	4 193	1 332	-	-

	Total*	Electricity	Pit coal, briquettes	Light heating oils	Propane and butane (LNG)	Heavy fuel oils	Natural gas (in gaseous form)
29 MACHINERY AND EQUIPMENT N.E.C	232 035	156 133	-	32 959	8 313	320	1 293
29.1 Machinery for the production/use of mech. power, exc. aircraft, vehicle engines	57 790	37 519	-	10 683	718	320	1 293
29.2 Other general purpose machinery	56 600	40 498	-	5 919	533	-	-
29.3 Agricultural and forestry machinery	37 592	20 573	-	7 761	6 050	-	-
29.4 Machine-tools	5 353	4 170	-	587	3	-	-
29.5 Other special purpose machinery	33 776	21 738	-	4 292	615	-	-
29.6 Weapons and ammunition	20 644	15 600	-	473	-	-	-
29.7 Domestic appliances n.e.c.	20 280	16 035	-	3 244	394	-	-
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	130 358	101 137	-	3 085	14 797	-	-
30 Office machinery and computers	1 891	1 648	-	56	-	-	-
31 Electrical machinery and apparatus n.e.c.	84 883	59 785	-	2 519	14 797	-	-
32 Radio, television, communication equipment and apparatus	16 750	15 940	-	254	-	-	-
33 Medical, precision and optical instruments	26 834	23 764	-	256	-	-	-
34-35(-35.114/5) TRANSPORT EQUIPMENT	231 331	167 346	-	26 683	6 240	-	-
34 Motor vehicles, trailers and semitrailers	102 619	75 669	-	17 319	3 953	-	-
35(-35.114/5) Other transport equipment	128 712	91 677	-	9 364	2 287	-	-
35.114/5 OIL PLATFORMS	77 333	59 309	-	7 242	3 422	31	-
36-37 MANUFACTURING N.E.C.	174 809	109 930	-	15 495	8 443	-	8 655
36.1 Furniture	87 201	66 484	-	12 837	83	-	-
36.2-6 Manufacturing n.e.c.	25 466	19 923	-	2 658	28	-	-
37 Recycling	62 142	23 523	-	-	8 332	-	8 655

Tab. 19.5.14: Energy expenditures excluding taxes (in thousands NOK) in 2001 broken down by industry sub-sector and type of energy carrier (only major types of energy carriers included). Source: Statistics Norway.

*Note: Total includes also minor fuels not shown in this table. Full table at <http://www.ssb.no>

Note: Electricity prices include grid rent.

Note: Average exchange rate in 2001: 1 NOK = 0.11138 US\$

From the table above one can see that the sector with the highest expenditures on energy is the basic metals sector with 3.8 bill NOK (US\$ 430 mill) spent in 2001 on energy. Within this sector, primary aluminum production accounts for 2.4 bill NOK (US\$ 263 mill) of energy costs, of which 2.2 bill NOK (US\$ 248 mill) were spent on electricity.

The sector with the second highest energy costs is the chemical industry with 2.1 bill NOK spent (US\$ 233 mill), followed by the paper and pulp sector with 1.6 bill NOK (US\$ 177 mill) spent in 2001.

Number of establishments (activity units) and production figures in 2000

Industry division (SIC 94)	Local kind of activity units	Persons employed	Compensation of employees	Production value	Costs of goods and services consumed	Value added at market prices	Gross investment
15-37 MANUFACTURING	11 394	281 842	95 209	490 360	345 935	144 425	16 202
15-16 FOOD PRODUCTS; BEVERAGES AND TOBACCO	1 658	53 153	15 538	115 999	84 483	31 516	3 809
15.1 Meat and meat products	242	12 690	3 601	29 359	25 364	3 995	660
15.2 Fish and fish products	523	12 240	3 136	24 315	19 999	4 316	1 005
15.5 Dairy products	81	5 387	1 768	13 038	10 851	2 187	349
15.3-4/6-8 Other food products	763	16 667	4 955	31 751	22 562	9 188	1 155
15.9/16 Beverages and tobacco	49	6 169	2 078	17 536	5 707	11 830	641
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	495	6 816	1 626	5 728	3 682	2 046	88
17 Textiles	329	4 763	1 167	4 063	2 584	1 478	66
18 Wearing apparel, dressing and dyeing of fur	131	1 530	336	1 163	737	426	19
19 Leather and leather products	35	523	123	502	361	141	4
20 WOOD AND WOOD PRODUCTS	998	14 638	3 893	17 842	12 641	5 200	303
21 PULP, PAPER AND PAPER PRODUCTS	98	8 855	3 420	20 342	14 014	6 328	1 794
22 PUBLISHING AND PRINTING ETC.	1 924	34 409	10 981	34 907	20 736	14 171	1 058
23-24 REFINED PETROLEUM PRODUCTS AND CHEMICAL PRODUCTS	200	14 498	6 420	72 091	58 791	13 300	3 209
23-24.1 Refined petroleum products and basic chemicals	92	8 731	3 935	58 114	49 185	8 929	2 774
24.2-7 Other chemical products	108	5 767	2 485	13 977	9 606	4 371	435
25 RUBBER AND PLASTIC PRODUCTS	355	6 710	2 095	7 656	5 096	2 560	406
26 OTHER NON-METALLIC MINERAL PRODUCTS	600	9 434	3 152	13 936	9 044	4 893	792
27 BASIC METALS	133	13 826	5 439	48 223	35 742	12 481	1 402
28 METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	1 250	20 340	6 331	20 021	12 061	7 960	472
29 MACHINERY AND EQUIPMENT N.E.C	1 266	23 690	8 600	30 298	20 115	10 182	812
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	779	21 321	8 997	34 362	23 027	11 335	937
30 Office machinery and computers	16	580	274	1 380	1 181	199	13
31 Electrical machinery and apparatus n.e.c.	359	9 150	3 510	12 276	8 047	4 229	356
32 Radio, television, communication equipment	79	5 352	2 460	11 428	7 687	3 741	378
33 Medical, precision and optical instruments	325	6 239	2 753	9 278	6 112	3 166	190
34-35(-35.114/5) TRANSPORT EQUIPMENT	677	20 235	6 515	27 676	19 663	8 012	561
34 Motor vehicles, trailers and semitrailers	118	5 631	1 916	6 520	4 390	2 130	320
35(-35.114/5) Other transport equipment	559	14 604	4 599	21 156	15 273	5 883	241
35.114/5 OIL PLATFORMS	104	19 174	8 086	25 896	17 024	8 872	-173
36-37 MANUFACTURING N.E.C.	857	14 743	4 116	15 384	9 815	5 569	733
36 Furniture and manufacturing n.e.c.	749	13 270	3 590	12 472	7 839	4 633	600
37 Recycling	108	1 473	525	2 912	1 976	936	133

Tab. 19.5.15: Number of establishments (activity units) and production figures in 2000.
Source: Statistics Norway.

Note: Average exchange rate for 2000: 1 NOK = 0.11395 US\$

19.5.5. Energy Efficiency Policies

A variety of energy efficiency policies are in place:

- Governmental program introduced in 1999 to analyze and increase industrial energy efficiency by switching raw materials. Pilot projects have been carried out in companies producing non-ferrous alloys, pulp, paper, and paperboard. These pilot projects showed an average reduction of electricity consumption by between 5% and 10%, sometimes with little or no capital investment.
- Statistics Norway collects energy statistics from industry. Industrial plants receive individual feedback on their energy performance in comparison with other companies in the same industry sector.
- Establishment of an “Industrial Energy Efficiency Network” in 1989. The network has currently a membership of 650 companies from 13 industries. The network provides members with assistance in energy monitoring, energy audits, and benchmarking.
- 1999 White Paper on Energy Policy.
- 2001 and 2002 White Papers on Climate Change Policy.
- CO₂ taxes on various fuels were introduced in 1991.
- A broad-based domestic greenhouse gas emission trading system covering about 80% of the Norwegian emissions will be introduced for the Kyoto-period 2008-2012. The trading system will be compatible with the international trading system under the Kyoto protocol.
- State funds allocated for energy efficiency measures of NOK 347.2 mill (= US\$ 38.5 mill) in 2001.
- Establishment of Regional Energy Efficiency Centers in each of the 19 Norwegian counties in 1999. Utilities could collect a surcharge of 0.003 NOK/kWh (~ 0.0004 US\$/kWh) on transmission tariffs to finance energy efficiency measures carried out through these centers.

- Creation of a new public agency, Enova, in Trondheim. Enova started its operation in January 2002. It is responsible for funding energy efficiency and renewable energy projects. Funding mainly comes from a fee on electricity distribution tariffs. Approximately NOK 5 billion (~ US\$ 680 mill) are available for a ten-year period starting in 2002.
- The Norwegian Government Environmental Fund is a loan scheme that provides funding for energy efficiency investments and other projects that helps to reduce greenhouse gas emissions.

Further information about energy efficiency policies in Norway can be found in:

- Energy Efficiency in Norway 1990-1999. A report based on the ODYSSEE database on energy efficiency indicators and the MURE database on energy efficiency policy measures with support from SAVE. http://www.ife.no/media/855_Odyssee-raport.pdf
- International Energy Agency: Energy Policies of IEA Countries. Norway 2001 Review. <http://www.iea.org/books/countries/2001/Norway.pdf>
- International Energy Agency: Energy Efficiency Update for Norway <http://www.iea.org/pubs/newslett/eneeff/no.pdf>

Existence of a national energy efficiency law or directive	yes
Existence of energy efficiency standards	yes
Existence of an agency responsible for energy efficiency policies	yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	yes

19.5.6. Carbon Credits

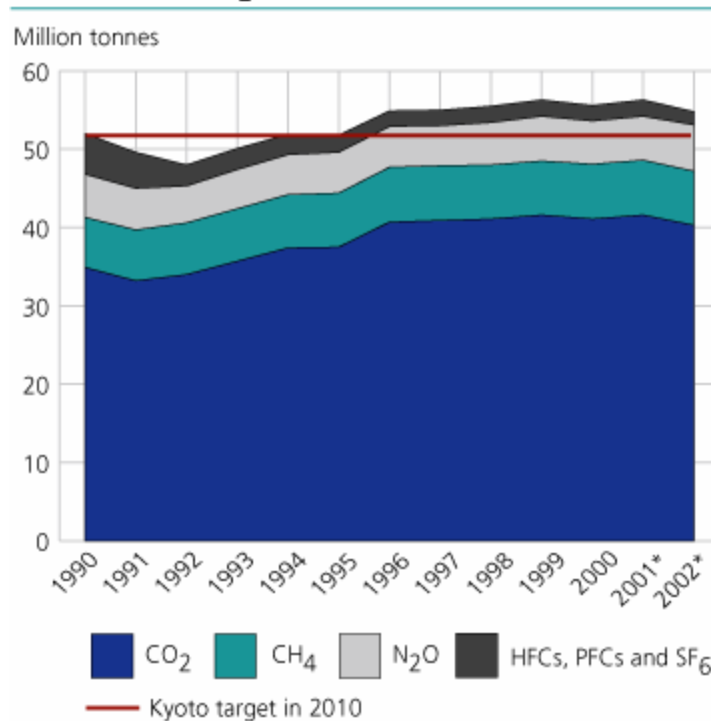
73 per cent of the total greenhouse gas emissions in 2002 came from CO₂, while methane and nitrous oxide constituted 13 and 11 per cent, respectively.

Total emissions of greenhouse gases (GHG) have increased by 5% from 1990 to 2002 (Fig. 19.5.3). However, GHG emissions (mainly CO₂ and SF₆) have been reduced by 2.5% from 2001 to 2002.

The decrease in CO₂ emissions was caused by lower activity in the ferroalloy manufacturing industry, less use of diesel in oil and gas production, reduced production of refined oil products and reduction in coastal traffic. Emissions of sulphur hexafluoride

(SF₆) were considerably reduced because of the closing down of the production of primary magnesium

Development in greenhouse gas emissions. 1990-2002.
Million tonnes CO₂ equivalents



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Fig. 19.5.3: Greenhouse gas emissions in Norway from 1990 to 2002.

Norway ratified the Framework Convention on Climate Change in July 1993 and signed the Kyoto Protocol in April 1998. The Norwegian commitment in the protocol is to limit the increase in greenhouse gas emissions to 1% between 1990 and the first commitment period from 2008 to 2012. Thus, Norway should reduce its GHG emissions by 4% from the level in 2002 until 2010, or acquire an equal amount of emission credits.

Since Norway signed the Kyoto protocol, opportunities for carbon credits for energy efficiency improvements will be available. The value of carbon credits for energy efficiency improvements in the industry sector will depend of the fuels used in the specific sector (see Tab. 19.5.13). Among the energy-intensive sectors, electricity (generated at 99 % from hydroelectric sources) is used at the following shares: 97 % in the aluminum production sector, 54 % in the chemical industry, and 41 % in the paper and pulp industry (all values for 2001).

Norway's total carbon dioxide emissions per GDP were 312 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is very low on an international comparison.

19.5.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 7,125

19.5.8. Risk

Political risk:	2
Economic risk:	2
Legal risk:	1
Tax risk:	3
Operational risk:	2
Security risk:	1

Overall risk: 2.00

Overall risk rating: Negligible

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

19.6 Thailand

19.6.1. Energy Efficiency Status

The following table compares the energy intensity in various manufacturing sectors in Thailand and in the USA.

Industry sector (ISIC Rev. 3)	Thailand	United States
Food and Tobacco	1,133	112
Textile and Leather	300	122 *
Wood and Wood Products		598
Paper, Pulp, and Printing		532 *
Chemical	1,195	705
Non-metallic Minerals	1,649	356
Iron and Steel		716
Non-ferrous Metals		558
Machinery		43
Transport Equipment		37

Tab. 19.6.1: Comparison of industrial energy intensity (energy use per value added) in Thailand and the US in 1999. Units: toe/mill 1995 US \$ PPP.

Notes:

* Energy intensity for US textile and paper, pulp, and printing sectors is from Tab. 19.1.1 and is for 1998 and these industry sectors are defined according to NAICS, which is not exactly the same as ISIC Rev.3.

From the table above one can see that Thailand has a very high energy intensity compared to the USA in the following sectors:

- **Food and tobacco**
- **Textile and Leather**
- **Non-metallic minerals**

19.6.2. Price of Energy

Electricity for industrial end-users (incl. Ft charge, excl. VAT) (June to September 2001):
2.5034 THB/kWh = 0.056 US\$/kWh

Natural gas price for industrial end-users in March 2003:
217.9 THB / mill BTU = US\$ 5.1 / mill BTU = US\$ 20.24 / Gcal = US\$ 202.4 / 10⁷ kcal

Source: National Energy Policy Office, Thailand.

The following figure depicts the natural gas price trend for industrial consumers in Thailand between 1998 and 2003:

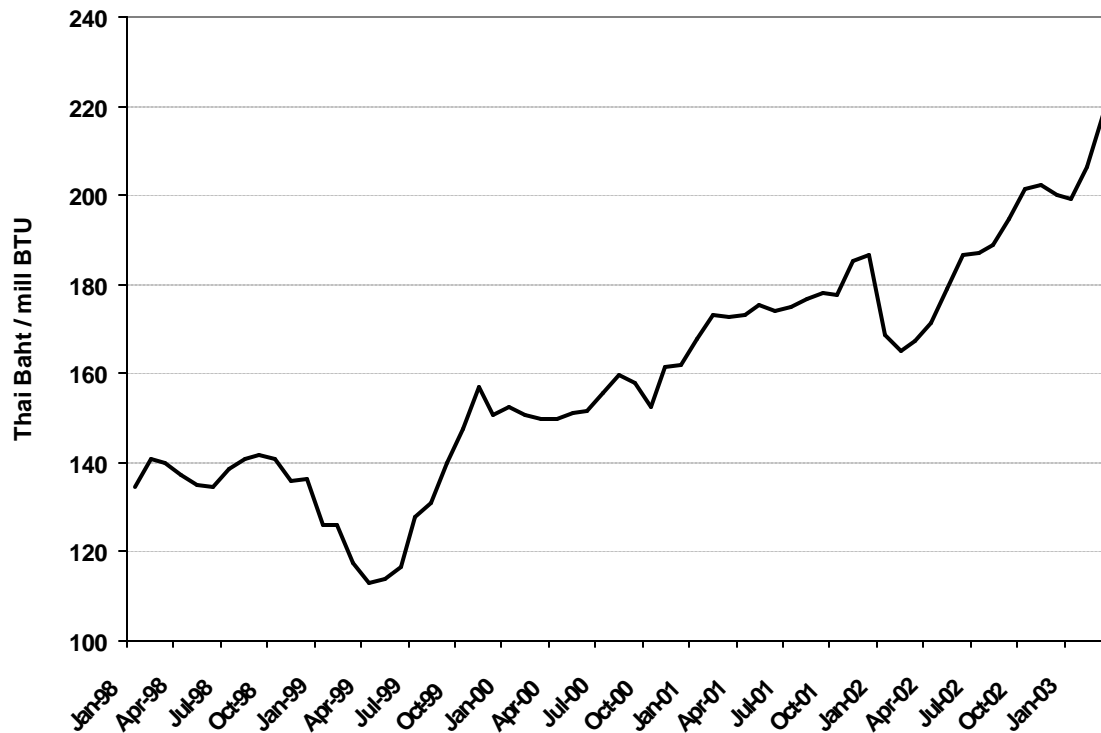


Fig. 19.6.1: Price of natural gas for industrial end-users in Thailand

Note: 1 THB = US\$ 0.0234 in March 2003

Source: Energy Policy and Planning Office, Thailand

The price for electricity for industrial consumers is medium to low, and the current price for natural gas is high by international comparison.

19.6.3. Growth Rate of Energy Consumption

The energy consumption grew by 3.1% on average between 1994 and 1999.

19.6.4. Potential Replicability of Exports (Size of Market)

The following table lists the number of establishments, the value of gross output, and the value added in Thailand's manufacturing sector in 2000:

Division of industry	Number of establishments	Value of gross output [mill US\$]	Value added [mill US\$]
Total	20,608	96,057	19,163
Manufacture of food products and beverages	3,102	15,721	2,553
Manufacture of tobacco products	198	1,032	823
Manufacture of textiles	1,358	8,228	1,457
Manufacture of wearing apparel; dressing and dyeing of fur	1,581	1,867	542
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	756	1,274	368
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	797	895	223
Manufacture of paper and paper products	487	2,466	562
Publishing, printing and reproduction of recorded media	796	1,007	342
Manufacture of coke, refined petroleum products and nuclear fuel	48	6,904	728
Manufacture of chemicals and chemical products	903	7,923	1,175
Manufacture of rubber and plastic products	1,684	5,311	1,162
Manufacture of other non-metallic mineral products	1,802	3,698	1,217
Manufacture of basic metals	476	3,476	439
Manufacture of fabricated metal products, except machinery and equipment	2,090	2,880	797
Manufacture of machinery and equipment n.e.c.	880	3,484	725
Manufacture of office, accounting and computing machinery	35	4,238	1,048
Manufacture of electrical machinery and apparatus n.e.c.	450	3,532	967
Manufacture of radio, television and communication equipment and apparatus	241	6,424	1,822
Manufacture of medical, precision and optical instruments, watches and clocks	119	775	143
Manufacture of motor vehicles, trailers and semi-trailers	938	11,835	1,248
Manufacture of other transport equipment	179	644	118
Manufacture of furniture; manufacturing n.e.c.	1,671	2,407	703
Recycling	16	38	4

Tab. 19.6.2: Manufacturing industry data for 2000.

Source: Report of the 2001 Manufacturing Industry Survey, Whole Kingdom. National Statistical Office, Office of the Prime Minister.

The International Institute of Energy Conservation estimated the achievable energy efficiency investment potential in Thailand's manufacturing industry (IIEC, 2000). The study indicates that the Thai industrial sector has a five- to seven-year achievable potential for energy efficiency investment within a range of US\$ 251 to 551 million, and a short-term investment potential between US\$ 16 to 39 million (the short-term potential refers to a demonstration phase that focuses on five facilities in each sub-sector and would be implemented over a two to three year time period).

The study specifies the investment potential by industrial sub-sectors:

Ind. sector	5 - 7 year potential		2 - 3 year potential	
	conservative	optimistic	conservative	optimistic
Chemical	2,696	5,654	173	374
Fab. Metal	2,105	4,769	92	226
Food & Bev.	3,515	7,276	166	352
Non-Metal	403	939	76	197
Textile	1,839	4,583	124	363
Paper	215	495	61	155
Total	10,773	23,716	693	1,667

Tab. 19.6.3: Industrial energy efficiency investment potential [million baht] (1 THB = 0.023 US\$).

Source: IIEC (2000).

Further information:

ITUT Centre for the International Transfer of Environmental Technologies, "Market Place Monitoring on Efficient Technologies in Thailand and Malaysia." Report available mid-2003 at
<<http://europa.eu.int/comm/europeaid/projects/asia-invest/html2002/publications.htm>>.

19.6.5. Energy Efficiency Policies

Thailand has a variety of energy efficiency policies in place. For detailed information see:

Department of Energy Development and Promotion (DEDP), Ministry of Energy
<http://www.dedp.go.th>

Energy Policy and Planning Office (EPPO), Ministry of Energy
<http://www.eppo.go.th/>

Energy Conservation Information Center
<http://www.thaienergy.net>

Information Service Center for the Energy Industry (ISCEI)
<http://www.energythai.net>

Existence of a national energy efficiency law or directive	Yes
Existence of energy efficiency standards	Yes
Existence of an agency responsible for energy efficiency policies	Yes
Availability of incentives (rebates, tax treatments, subsidies) for energy efficiency improvements	Yes

19.6.6. Carbon Credits

Thailand signed the UN Framework Convention on Climate Change (UN FCCC) in June 1992 and ratified it on December 28, 1994. Thailand signed the Kyoto Protocol on February 2, 1999 and ratified it on August 28, 2002. Thailand is not a member of Annex I Parties to the UN FCCC. Consequently, it is not obliged to reduce its GHG emissions under the Kyoto Protocol. However, it may become a potential partner for Clean Development Mechanism projects.

Thailand's total carbon dioxide emissions per GDP were 565 g CO₂ per US\$ (PPP) in 1999. This carbon intensity is about the average on an international comparison.

19.6.7. Financing

Gross fixed capital formation (current US\$) per capita in 2000 = 438

19.6.8. Risk

Political risk:	4
Economic risk:	5
Legal risk:	4
Tax risk:	4
Operational risk:	3
Security risk:	3

Overall risk: 4.1

Overall risk rating: Medium

Risk ratings are from 1 (minimal risk) to 9 (maximal risk).

19.7 USA (for comparison only)

For the purpose of comparison, the following table lists the energy intensity in the US industry sectors:

Industry sector (ISIC Rev. 3)	Energy intensity
Food and Tobacco	112
Textile and Leather	122 *
Wood and Wood Products	598
Paper, Pulp, and Printing	532 *
Chemical	705
Non-metallic Minerals	356
Iron and Steel	716
Non-ferrous Metals	558
Machinery	43
Transport Equipment	37

Tab. 19.7.1: Industrial energy intensity (energy use per value added) in the US in 1999.
Units: toe/mill 1995 US \$ PPP.

Note:

* Energy intensity for US textile and paper, pulp, and printing sectors is for 1998 and these industry sectors are defined according to NAICS, which is not exactly the same as ISIC Rev.3.

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Regional studies:

APERC (2001) “Energy Efficiency Indicators: A Study of Energy Efficiency Indicators in APEC Economies,” Asia Pacific Energy Research Centre, Institute of Energy Economics, Shuwa Kamiyacho Building, 4-3-13 Toranomon, Minato-ku, Tokyo, 105-0001 Japan, March 2001.

http://www.ieej.or.jp/aperc/2001/Efficiency_Part1.pdf

http://www.ieej.or.jp/aperc/2001/Efficiency_Part2.pdf

This study covers energy efficiency indicators and policies in APEC member countries.

ENERDATA: World Energy Statistics and Information Database

http://www.enerdata.fr/enerdata_UK/indexa.html

This database covers all countries of the world and gives plenty of information about energy efficiency, energy markets, and other energy-related information.

International Energy Agency: Energy Efficiency Initiative (1998)

<http://www.iea.org/pubs/studies/files/danish/index.htm>

This study focuses on energy efficiency in countries of the Commonwealth of independent states, in Central and Eastern European countries, and in IEA member countries.

International Energy Agency: Energy Efficiency Policies (2000-2002)

<http://www.iea.org/pubs/newslett/eneeff/table.htm>

This publication covers energy efficiency policies in IEA countries. The individual country reports are updated on a regular basis.

ODYSSEE Database

http://www.enerdata.fr/enerdata_UK/indexa.html

<http://www.odyssee-indicators.org/Publication/PDF/RapFra.pdf>

This database covers energy efficiency indicators in 15 countries of the European Union plus Norway. Single country reports are available at www.odyssee-indicators.org.

Phylipsen GJM, Blok K., Worrell E. (1998) “Handbook on International Comparison of Energy Efficiency in the Manufacturing Industry,” Utrecht University.

World Energy Council: Energy Efficiency Policies and Indicators (2001)

<http://www.worldenergy.org/wec-geis/global/downloads/eeip1.pdf>

<http://www.worldenergy.org/wec-geis/global/downloads/eeip2.pdf>

This study covers various countries in all regions of the world.

21. Units and Conversions

$$1 \text{ Mtoe} = 10^3 \text{ ktoe} = 10^6 \text{ toe} = 10^9 \text{ koe}$$

$$1 \text{ koe} = 4.1868 \times 10^7 \text{ J} = 39680 \text{ Btu} = 11.63 \text{ kWh}$$